JOURNAL

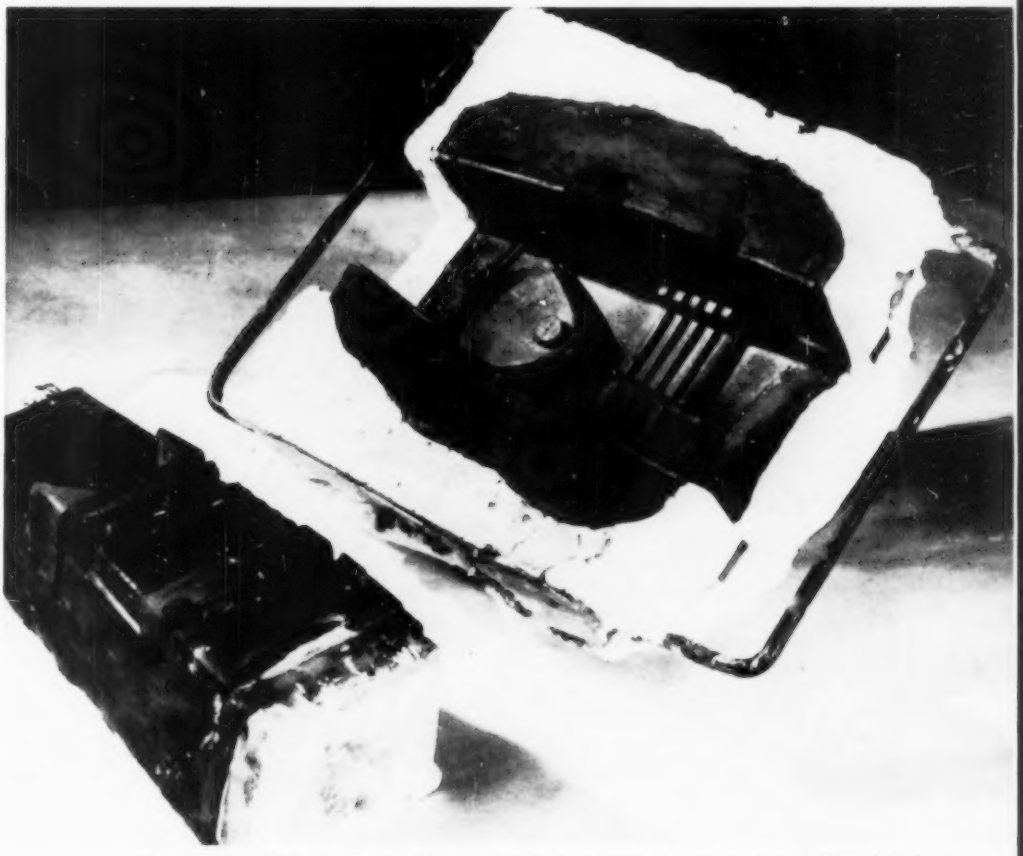
VOLUME 11, NUMBER 10 OCTOBER, 1955

UNIVERSITY OF MICHIGAN

OCT 25 1955

EAST ENGINEERING

Prototype Molds of Plastisol



Prototypes of electric appliance parts for market tests are produced in less time and at a saving of as much as 90 per cent in costs with the use of vinyl resins in a new flexible mold process. General Electric Company's Small Appliance Division developed this process for producing at nominal cost prototypes of electric iron handles, clock cases and fan motor or reactor housings which are used to test consumer acceptance of new designs. From 12 to 20 prototypes of uniform quality are cast from a single flexible mold preserving the intricate detail and thin wall sections.

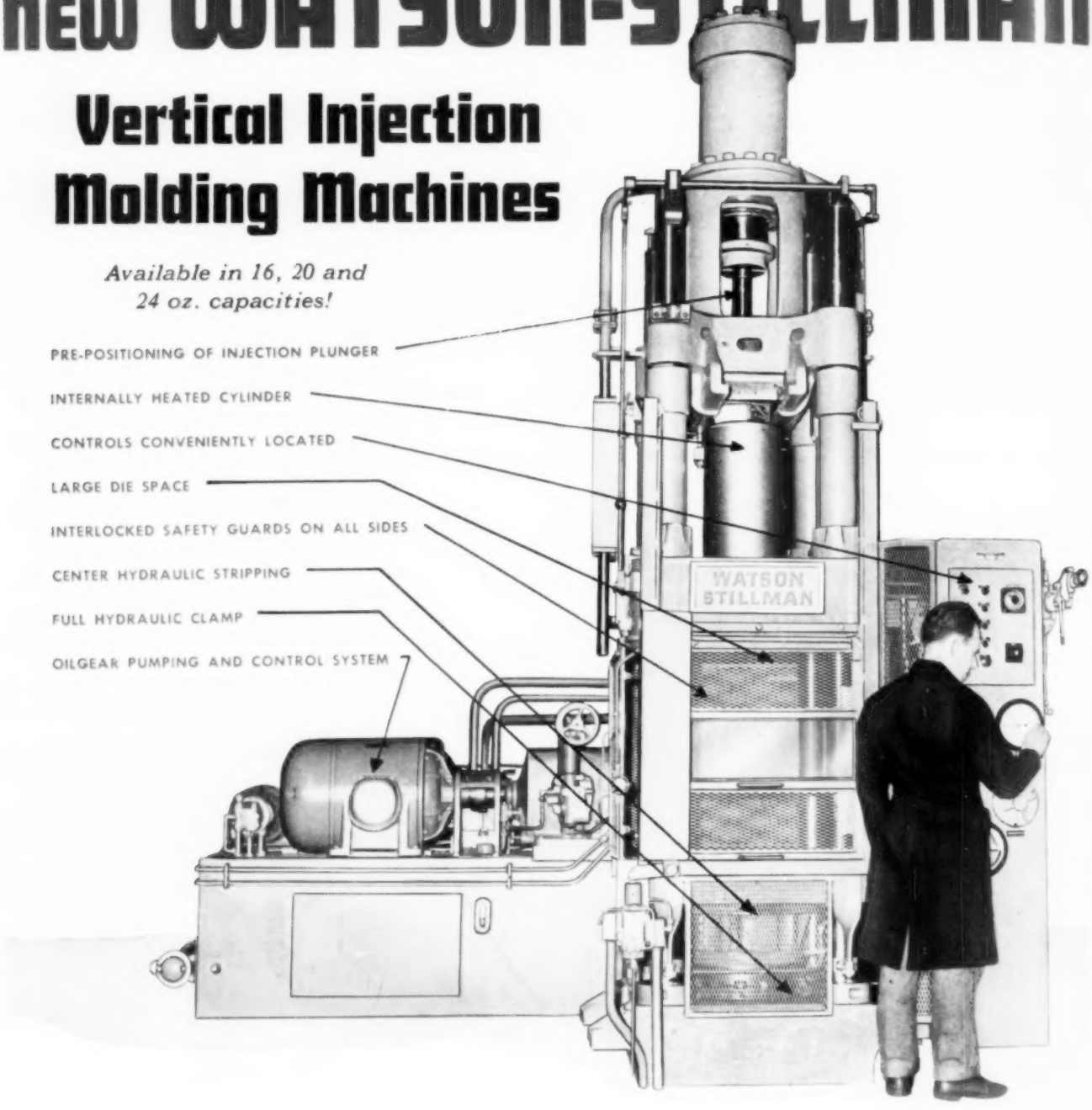
(Photo Courtesy Bakelite Co.)

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

new WATSON-STILLMAN

Vertical Injection Molding Machines

Available in 16, 20 and 24 oz. capacities!



The 20 oz. unit shown above—like all Watson-Stillman Vertical Injection Molding Machines—is designed and built to meet your demand for a machine that provides low-cost, high-speed production.

In addition to the conventional molding of thermo-plastics, these versatile units are particularly adapted to the molding of parts requiring inserts.

The W-S "Completeline" of Vertical Injection Machines ranges in size from 1 oz. to 24 oz. capacities. W-S also manufactures a "Completeline" of horizontal injection molding machines in a wide range of capacities from 5 to 500 ounces. Whatever your production requirements, it will pay you well—in increased production and impressive savings in operating costs—to check with W-S first.

A DIVISION OF HKP H. K. PORTER COMPANY, INC.

THE WATSON-STILLMAN COMPANY
DIVISION OF H. K. PORTER COMPANY, INC.
153 Aldene Road, Roselle, N. J.
Foreign Sales Representative: OMNI PRODUCTS CORP.,
460 Fourth Avenue, New York 16, N. .Y.
Correspondents Throughout the World

W-S HYDRAULIC
ESTABLISHED 1845

SPE JOURNAL

Vol. 11 October, 1955 No. 8

Published monthly except July and August by

THE SOCIETY OF PLASTICS ENGINEERS, INC.

30 cents a copy **$3.00 per year**

Copyright by the Society of Plastics Engineers, Inc., 1955

JESSE H. DAY, Editor

Editorial Offices

SECURITY BANK BUILDING
ATHENS, OHIO

Executive and Business Offices

34 EAST PUTNAM AVE.
GREENWICH, CONN.

Officers of the Society

FRANK W. REINHART, President
ERNEST P. MOSLO, Vice President
JULES W. LINDAU, III, Secretary
HAIMAN NATHAN, Treasurer
P. J. UNDERWOOD, Executive Sec'y.

Editorial Advisory Board

SAUL BLITZ, ALLAN HUTCHINGS, MARIO PETRETTI, WAYNE PRIBBLE, ROBERT SACKETT, GORDON THAYER, EDWARD VAILL

• *All correspondence dealing with business matters, membership, advertising and the like should be addressed to the Business offices listed above.*

• *All copy intended for publication in the SPE Journal should be directed to the Editorial Offices. Copy for each issue should be received at Athens, Ohio, before the first of the preceding month. Neither The Society of Plastics Engineers nor the SPE Journal is responsible for the views expressed by individual contributors.*

• *Entered as second-class matter at the Post Office at Athens, Ohio.*

This new experimental tire, developed jointly by United States Rubber Co. and Dow Corning Corporation, is a close relative of a window pane. Quartz and sand derivatives are basic ingredients of the silicone rubber-glass fiber tire, which will withstand a temperature range of nearly 600 degrees. Silicon is used in making the silicone rubber for the tread. Glass fibers are used in the carcass. Commercial application to automotive vehicles is not likely at this time, but the tires may be suitable for high speed super-sonic aircraft where the tires may be exposed to temperatures of more than 400 degrees.

INDEX

SPE Plans Kodachrome Slide Library for Sections and Schools 5

ARTICLES

Will the Polyethylene Gamble Pay Off?—E. S. Childs 11

Recent Advances in Isocyanate Resins—Irving Katz 16

Plastics Engineers—When?—Lloyd A. Chacey 25

Use the Right Material—J. H. DuBois 26

FEATURES

Book Reviews 4

Action by Your National Organization 9

Plastics Around the World 30

The Injection Molderscope 34

News of the Sections 37

Classified Ads 38

ADVERTISER'S INDEX 38

In highest favor for

IMPROVED IMPACT

DUREZ

IMPROVED IMPACT

1544

BLACK AND BROWN

. . . perfect for **PREFORMING** *too!*

It's the standard of the industry! No other conventional type material with minimum impact strength of .40 ft. lb. per in. preforms so easily in automatic machines. Molders tell us they use more "1544" than all others of its type put together. They say, "It's the equal of general-purpose materials in molding performance yet meets higher impact specifications... Fine gloss surface... Electrical values very good." You will find it profitable to use "1544" on many applications.

DUREZ PLASTICS DIVISION
HOOKER ELECTROCHEMICAL COMPANY
1110 WALCK ROAD, NORTH TONAWANDA, N. Y.

Send for Data Sheet

Specifications and further details gladly supplied on request

DUREZ®

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- PROTECTIVE COATING RESINS

PHENOLIC PLASTICS THAT FIT THE JOB

Book Reviews . . . .

PACKAGING ENGINEERING, Louis C. Barail, Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y. Cloth 6" x 9", 407 pages.

This is a comprehensive study compiled for the assistance of the "Packaging Engineer." The author discusses all types of packages, packaging materials, packaging methods, and packaging machinery. Separate chapters are devoted to the packaging of certain items such as: Food, Drugs, Cosmetics, and Armed Forces Material. It suggests means of protecting the contents of a container from such forgotten hazards as corrosion, micro-organisms, insects, rodents, odors, oxidation, and unsanitary environment.

Of particular interest to our society is the chapter on Plastics, which lists the many plastic materials available for packaging, along with their chemical and physical properties and principal uses. It also describes various plastic containers including: rigid, semirigid, flexible as well as film both by itself and with other materials.

Another chapter includes complete export packaging requirements as well as a glossary in English, French and Spanish. Appendices include sources of "Educational Material," Bibliography, List of Government Specifications and an Index.

In as much as the author goes into great detail, this book can be of immeasurable value to anyone aspiring to the packaging industry. To the seasoned packaging expert it provides "food for thought" on many hazards that are often over-looked.

Edward W. Rowan.

Compare!

IMS SILICONE SPRAY

FASTEST PRESS OPERATORS *WANT IT!*

COST CONSCIOUS MOLDERS *SPECIFY IT!*

Don't be fooled!

IT'S Quality IT ISN'T SIZE— THAT COUNTS

All Metal Head Saves Cycle Time

Remember: IMS *silicone shipments are prepaid*

PRICES:	(Delivered Free)	Sample Can	$2.00
		Unbroken Gross .	$197.40
		Unbroken Dozen .	$18.00

DON'T BE MISLED — LOOK OUT FOR IMITATIONS

INJECTION MOLDERS SUPPLY CO.

3514 LEE ROAD • WYoming 1-1424 • CLEVELAND 20, OHIO

Kodachrome Slide Library Planned for use by SPE Sections and Schools

The Educational Committee of The Society of Plastics Engineers has undertaken to provide a library of Kodachrome slides that will be available for use by local sections to promote interest in plastics engineering among high school and college students.

A plan is being developed by Professor Louis R. Rahm of Princeton University to catalog and make the films available in a manner that will be most useful to The Society of Plastics Engineers' membership.

Volunteers are requested from the entire SPE membership to provide Kodachromes that will be suitable for this collection. Undoubtedly, a very high percentage of the SPE members are amateur photographers and have already taken a number of Kodachrome slides that may be suitable for this work. All persons are requested to send their contributions directly to J. H. DuBois, 29 Erwin Park Road, Montclair, New Jersey, along with a brief description of the subject matter covered by the slides. Donations of all types will be welcome, covering the materials, processes, markets, tools, toolmaking methods, machinery and equipment used by the plastics industry.

The attached list has been prepared as a check list to make sure that all phases are covered. It is hoped that certain sections will undertake to provide slides as a local project. As soon as the voluntary contributions have been checked, a secondary approach will be made to the local sections to get specific work done based on the facilities available in each section.

A special effort will be made to solicit Kodachrome slides from the publicity and advertising managers of the materials and equipment manufacturers for the plastics industry.

SUBJECTS FOR SPE PLASTIC'S LIBRARY OF 35 MM. KODACHROME SLIDES

Acrylic Plastics, Presses — Hand, Semi-Automatic, Automatic, Fully Automatic, Manual. Accordian Mold, Accumulator, Alkyd Resin Products, Angle Guide Pen, Ashing, Autoclave.

Auxiliary Plunger Mold—Top Ram, Bottom Ram, Slide Ram, (Transfer Mold), (Die Cast Mold), Blanking, Blow Molding, Calendering, Casein Plastics, Cast Phenolic, Cellulose Plastics, Centerless Grinder, Cold Flow, Cold Molded Plastics, Combination Mold, Compounding, Compression Molding—Compression Molds, Contact Molding, Cooling Fixtures, Crosshead Extruder, Cull.

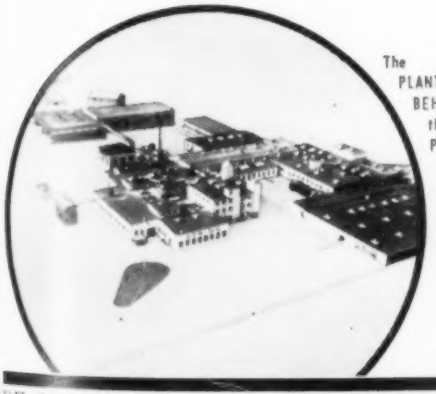
Decorating Plastics—Air Brushing, Etching, Metal Inlays, Painting, 3-D, Metallizing, Roll Leaf, Decal, Pantograph Engraving, Printing; Direct Gate, Disc Gate, Double Gate, Double Shot Molding, Drying (compound), Duplicating Machine, Edge Lighting, Ejector Pins (Knock out pins), Elastic Memory, Electroformed Molds, Electronic Heat Sealing, Electronic Preheating, Embediments, Embosing, Epoxy Resins, Expanded Plastics, Extrusion of— Sheets, Rods, Tubes, Layflat; Extrusion Dies, Fan

(Please turn to page 6)

GERING ..... MOLDING POWDERS ... for GREATER PRODUCTION

CUSTOM COMPOUNDING OF all plastics

If your facilities are crowded, or your THERMOPLASTIC products require special processing techniques, it will pay you to talk to GERING before investing in production machinery.



WE are completely staffed with Laboratory, Technical and Engineering personnel; and equipped with BANBURY MIXERS — MILLS — EXTRUDERS — GRINDERS — PELLETIZERS — BLENDERS — BAGGERS and MATERIALS HANDLING EQUIPMENT to produce under your label large quantities of molding and extrusion compounds in any formulation of all thermoplastics, including POLYETHYLENE, VINYLS, NYLON, ACRYLIC, CELLULOSE ACETATE, BUTYRATE, ETHYL CELLULOSE, POLYSTYRENE and its COPOLYMERS.

. . . and behind our plant, equipment, production and personnel are 31 years of learning HOW.

GERING Products • Inc.
KENILWORTH, N. J.
Conversion Specialists • Plastics Raw Materials
"PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS"

SPE Plans Kodachrome Slide Library for Education . . .

(Continued from Page 5)

Gate, Finishing Molded Parts by Filing, Knifing, Sanding, Buffing to Rubbing, Punching, Sawing.

Flame Polishing, Fluorothene Plastics— Kel F, Teflon. Flash, Flashmold, Flexible Molds, Flush Parting Line, Force Plate, Forming—all types. Fritction Welding, Gang Mold, Glass Bonded Mica, Glass Fibres, Glazing, Granulating Machine, Grit Blasting, Hand Molds—Compression—Transfer. Hat Press, Heat Sealing, Heating Molds — Electrical, Water/Steam, Gas. High Frequency Preheating, High Pressure Laminating, Hobbing, Hot Melt Coatings, Hot Forming, Housings for Machines, Injection Molding Machines, Injection Molds, Inserts, Jig Borer, Jigs.

Kick Press, Laminates hi-presure — lo-pressure, continuous, decorative, molded. Land (Mold), Landed Plunger Mold, Lapping, Lathe, Lettering for Plastics, Loading Board, Loading Space, Loading Shoe Mold, Loose Wedges, Melamine Plastics, Migration, Milling, Models for Plastics, Mold Lubricating, Mold Making (All basic operations), Mold Marks, Molding Boards, Mottles, Nameplates, Nylon, Orientation, Ovens for Plastics, Packaging Uses for Plastics, Parallels, Parting Line, Permeability, Phenolic Resin, Photoengraving, Polymerization, Pickup, Pipe (extruded), Plasticizers.

Short Shots, Side Cores, Silicones, Sleeve Ejector, Sink Mark, Slitting, Slush Casting, Spindling, Split Cavity Mold, Sprayed Molds, Spring Box Mold, Sprue, Sprue Puller, Squeeze Ring, Standard Gate, Steels for Plastics Molds, Stepped Parting Lines, Stippling in Molds, Stretch Forming—Yoke Forming, Plug and ring Forming, Slip Forming, Grease Forming. Stripper Plate Mold, Stuffing Machines, Support Pin, Swaying, Polyester, Polyethyl, Polystyrene, Positive Mold, Port, Postforming, Potting Compounds, Preforms, Preheating Molding Materials — All Methods — Hotplate, Oven, Infrared, Dielectric, Steam.

Press Polishing, Processing Machinery for Plastics, Protein Plastics, Punching, Reinforced Plastics, Resin Making, Ring Gate, Routing, Runner, Sanding, Sealing Bands, Sealing Ring, Seed, Semi-Positive Mold, Shaper, Shearing, Sheeting, Sewing Mold, Tableware (plastics), Tandem Mold, Thermosetting, Thermoplastic, Toggle Action, Tooling (Plastics), Topping, Transfer Molding and Molds, Tumble Finishing, Turning, Undercuts, Urea, Vacuum Forming, Vinyls (all types), Vulcanizing, Wedge Mold, Weld Marks.

Victory Mfg. Co. Still In

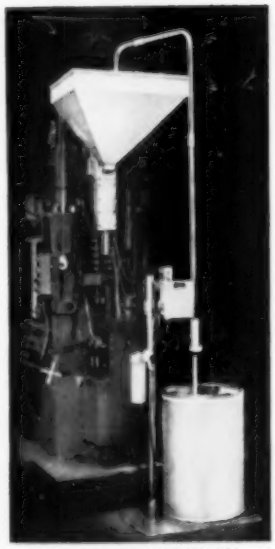
Victory Manufacturing Co., quarter-century-old Chicago plastics molder, has no connection whatever with Victory Plastics Co. of Hudson, Mass. (which has announced that it is discontinuing the manufacture of plastics housewares).

Mr. Edward Singer, Victory-of-Chicago's president, issued that statement to a SPE Journal interviewer—"to help avoid confusion."

We're very much IN business, Mr. Singer explained. In fact, he continued, Victory-of-Chicago has only recently aded considerable floor space and several new pieces of the most modern equipment.

Victory-of-Chicago molds plastic products for the housewares, notions, adult game, toy, premium and ad specialty fields — and does an important custom molding business, as well.

See HOW EASY IT IS NOW TO KEEP YOUR HOPPERS FULL!



MODEL 512A FULLY AUTOMATIC
(Photo Courtesy Lester-Phoenix Inc.)

It's All Done AUTOMATICALLY

Save time and labor by providing each of your presses with a Whitlock Automatic Hopper Loader. Transfers materials automatically from any container at floor level to hopper, regardless of height of hopper or distance of container from press.

Keeps materials at a constant level in the hopper, insuring a uniform supply to the heating cylinder.

Handles all free-flowing granular or pelletized materials, including most regrounds. Easily handles up to 12 lbs. per minute.

Operates by compressed air. Requires only approximately 1 H.P. of compression per unit. Shuts the air off when the hopper is full and turns it on when material is needed.

WRITE FOR LITERATURE

C. H. WHITLOCK ASSOCIATES
21657 COOLIDGE HIGHWAY OAK PARK 37, MICH.

Whitlock AUTOMATIC HOPPER LOADER

Drawer liners for **Sears, Roebuck and Co.** "Caravan" furniture are produced by *Panelyte Division*, **St. Regis Paper Co.**, Chicago 41, Ill.

Vacuum-formed impact styrene trays... big selling point at low cost

Here's a design idea that's helping to sell Sears' "Caravan" furniture—drawer liners vacuum-formed from extruded sheets of BAKELITE Brand High-Impact Styrene.

Easy cleaning makes them a hit—notice the rounded corners. The housewife merely wipes these trays clean, though they can readily be removed and washed without harm. Their smooth surfaces don't snag fabrics. Their color complements the natural wood of the drawers.

These sales advantages are inexpensive, too, because vacuum-forming is a fast, economical production method. And BAKELITE High-Impact Styrene TGD-5001 was developed especially for vacuum-forming. Since sheets of TGD-5001 are still glossy after forming, no extra finishing operations are needed. TGD-5001 offers a range of attractive colors, and demonstrates excellent toughness in service.

Learn more about BAKELITE High-Impact Styrenes for extrusion and vacuum-forming. Write today to Department KW-171.

BAKELITE BRAND High-Impact Styrenes

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

Just one year old—the industry's pace-setting general purpose phenolic molding compound!

When we introduced new DURITE GP-102 last May . . . we promised a pace-setting phenolic molding compound.

Today—results such as these obtained by leading molders have proved the superiority of GP-102 beyond any doubt:

Faster curing—GP-102 steps up production as much as 25% from each press.

Exceptional versatility—GP-102 is ideal for large moldings or small, intricate or simple, thin-walled or heavy-sectioned.

Uniform quality—GP-102 assures you of consistently high quality in every piece you mold . . . because it is carefully controlled from raw materials to the finished compound. Batch to batch uniformity is assured.

You can get prompt delivery of GP-102—in either black or brown—from our stocks at major industrial areas. For a sample, or to have a Durite technical representative demonstrate its advantages in your plant, write: The Borden Company, Chemical Division, DURITE Products Dept. SPE-105, 5000 Summerdale Ave., Philadelphia 24, Pa.

DURITE

THE *Borden* COMPANY
CHEMICAL DIVISION

Phenolic Molding Compounds • Abrasive and Frictional Bonding Resins • Molding and Specialty Resins • Lamp Basing Cements

Action— By Your National Organization

"The objects of the Society shall be to promote in all lawful ways the Arts, Sciences, and Engineering Practices and Standards connected with the utilization of plastics."

PAC STEPS FORWARD

by Don F. Hoffman, PAC Administrator

(Continued from the September issue)

A new Committee under PAC, Plastics in Building, is in the process of being formed. This committee will work with the Building Research Institute to keep abreast of developments in the plastics field which are of particular interest to the building industry. It will be a purpose of this committee to collate and disseminate engineering data which would be of particular interest in construction. It is intended that its membership should comprise representatives from all Sections of SPE so that the National Committee may be kept up to date on regional activities in this field. As a result of collecting data from many sources this committee should have considerable influence on manufacturing processes related to necessary materials. When the committee is complete and its chairman selected this work will be under the supervision of J. H. DuBois.

The first of a proposed series of Regional Technical Conferences will be sponsored by the New York section, SPE in November 1955. The subject of this conference will be, "Plastics For Packaging." Letters have been sent to all Section Presidents, Section PAC Chairmen, and National Council members requesting that each section consider the possibility of its sponsoring a regional conference on a specific field within the plastics industry. Subjects such as calendering, wire and cable, epoxy resins, new polyethylenes, test methods, adhesives, polyamides, and many more have been suggested. It is hoped that many of the smaller SPE Sections particularly will be able to handle arrangements necessary for one of these conferences and thus not only help in the national activity of the Society but gain in their own section experience as well.

The work of another PAC Committee is of direct interest to you. It is the Technical Advisory Committee under the Chairmanship of William O. Bracken of the Philadelphia Section. It handles inquiries of a technical nature that are received by the Society. To date 28 such inquiries have been received and processed. Mr. Bracken reports that these questions put to the four subcommittees (namely, Thermoplastics, Thermosetting, Tools & Equipment, and Reinforced Plastics) have given the committee members plenty of mental exercise. It is believed that their deliberations have contributed much worthwhile help to both companies and individuals engaged in the plastics field. For example, the questions posed ranged from durability and strength of polyamide plastic gears compared with ferrous and nonferrous metals; reinforced plastics for prosthetic devices; calculations for extruded die dimensions for polyethylene; automatic degating of round injection molded parts; test methods for evaluating plastic coatings on metals, and so forth. Of course, from time to time inquiries are received which are best handled by other associations such as the SPI. For example, best methods for merchandising granulating equipment is a typical one. These are referred to the appropriate organization.

One interesting feature is the number of inquiries from abroad that are received by the Society. We are particularly pleased to collaborate with our British cousins from the British Standards Institute on such specifications as standards for thin and thick polyvinyl chloride sheeting and molded plastic ash trays, etc.

If you have technical questions pertaining to the plastics industry wherein you feel the Technical Advisory Committee can be of help forward them to the National Offices of the Society. If the inquiry meets with the criteria of (1) being of a technical nature, (2) applies to the plastics industry and (3) does not violate any company confidences, the PAC Technical Advisory Committee will be more than happy to be of whatever assistance it can.

This has been the second in a series of reports to the membership by PAC, the Professional Activity Committees of the Society.

A TECHNICAL REPORT from Du Pont

• *Properties and application data on "Lucite" acrylic resin*

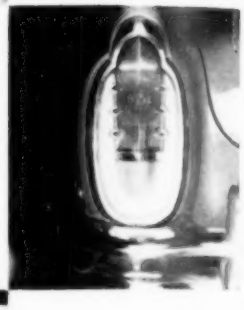
"Lucite" acrylic resins are available with a wide range of molding characteristics and properties and in a variety of transparent, translucent and opaque colors.

"Lucite" offers many design possibilities in industrial applications, especially where visibility of operations is of importance. Transparency, strength, resistance to impact and crazing, chemical resistance, lightness and ease of molding and extruding make "Lucite" a useful as well as a decorative material.

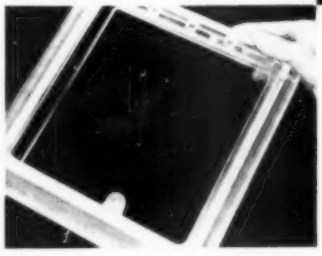
This engineering material is about one-third the weight of glass and features high impact strength even at relatively low temperatures. The optical properties of "Lucite" are excellent—it transmits about 92% of incident light. Aging, sunlight and moisture have little, if any, effect on "Lucite." A unique property: The ability to "pipe" light around angles up to 48° and curves with radii equal to 3 times the thickness of the material.

For further information on "Lucite" or the other Du Pont engineering materials write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 4210 Du Pont Building, Wilmington 98, Del. In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec.

Brush backs and similar items utilize the strength, beauty and chemical resistance of "Lucite."



Excellent optical properties, together with a unique ability to "pipe" light, make "Lucite" ideal for automotive applications—taillight lenses, instrument panels, and so forth.



This cold-storage-cabinet lid, injection-molded of "Lucite," is subjected to low temperatures, rough handling. It permits easy inspection of freezer contents.

PROPERTIES OF MOLDED "LUCITE" 29 AND 129

MECHANICAL PROPERTIES

		Units	A.S.T.M. Method	
Tensile strength	70° F.	lb./sq.in.	D638-49T	14,500
	73° F.	lb./sq.in.	D638-49T	10,000
	170° F.	lb./sq.in.	D638-49T	4,300
Elongation	70° F.	%	D638-49T	2
	73° F.	%	D638-49T	5-10
	170° F.	%	D638-49T	90
Modulus of elasticity	77° F.	lb./sq.in.	D638-49T	400,000
Shear strength		lb./sq.in.	D732-46	9,000
Impact strength, Izod	40° F.	ft.lb./in.	D256-47T	0.3
	73° F.	ft.lb./in.	D256-47T	0.3
Stiffness	77° F.	lb./sq.in.	D747-48T	410,000
Flexural strength	73° F.	lb./sq.in.	D790-49T	15,500
Compressive stress at 1% deformation		lb./sq.in.	D695-49T	4,600
Hardness, Rockwell			D785-51	M93

THERMAL PROPERTIES

Flow temperature	°F.	D569-48	274
Coefficient of linear thermal expansion per °F.		D696-44	5×10^{-5}
Thermal conductivity	B.T.U./hr./sq.ft./°F./in.	(Cenco-Fitch)	1.4
Specific heat			0.35
Deformation under load, 122° F., 1000 lb./sq.in.	%	D621-48T	1.15
Heat distortion temperature, 264 lb./sq.in.	°F.	D648-45T	167
65 lb./sq.in.	°F.	D648-45T	184

ELECTRICAL PROPERTIES

Dielectric strength, short-time	v./m.l.	D149-44	400
step-by-step	v./m.l.	D149-44	400
Volume resistivity	ohm-cm.	D257-49T	$>10^{15}$
Dielectric constant, 60 cycles		D150-47T	3.9
10^3 cycles		D150-47T	3.3
10^5 cycles		D150-47T	2.9
10^6 cycles		D150-47T	2.7
Power factor, 60 cycles		D150-47T	0.042
10^3 cycles		D150-47T	0.042
10^5 cycles		D150-47T	0.025
10^6 cycles		D150-47T	0.011

OPTICAL PROPERTIES

Index of refraction	n_D	D542-42	1.49
Luminous transmittance, Illuminant C, 1/8 in.	%	D791-49T	>91
Transmittance at 4500 A°, 1/8 in.	%	D791-49T	90
Haze	%	D1003-49T	<3

MISCELLANEOUS PROPERTIES

Water absorption	%	D570-42	0.28
Flammability	in./min.	D635-44	1.5
Specific gravity		D792-48T	1.18
Mold shrinkage	in./in.		0.002-0.006
Compression ratio		D392-38	1.8-2.2

(Data shown are average values and should not be used for specifications.)

ZYTEL® nylon resin · **ALATHON®** polyethylene resin · **TEFLON®** tetrafluoroethylene resin · **LUCITE®** acrylic resin

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Will the . . .

Polyethylene Gamble Pay Off?

E. S. Childs
Monsanto Chemical Co.

THAT QUESTION IS discussed wherever people gather to talk of plastics and the future. Plastics industry prophets, and forecasters outside our industry arrive at startling predictions for polyethylene after viewing their crystal balls and reading about production capacity expansion for this thermoplastic. Agreement is universal that rapid growth will occur. Differences in predictions are concerned mainly with the rate of growth and the consuming industries in which it will occur. Realization of these opportunities demands a variety of product properties, processing characteristics and usually a lower price. Consequently, to determine what the odds are for pay-off in polyethylene futures, it is necessary to study the markets and to see what they require in terms of raw material and product properties, processing characteristics and price.

In analyzing future prospects for polyethylene consideration should be given first to where the industry is today. Of some importance is the relationship that has existed between supply and demand. Not until the middle of 1954 did a molder feel that he could proceed with a cash outlay for a new mold and have the confidence that molding material would be freely available to him when the mold was delivered. Similar situations existed in the other areas of end use. Since many months roll by between the conception of an idea and its successful introduction on the market, polyethylene's near future prospects can be expected to be benefited by an influx of new products and new ideas. Imagination, invention and generation of new ideas combined with a studied consideration of where polyethylene could be used to advantage should be stimulated by the assurance of continuing availability.

Another factor influencing the current market situation was the use of polyethylene in applications essential to the National defense effort during the Korean War period. Thus, experience gained in military barrier-wraps, shell liners, fuses, food boxes, wire and cable insulation permitted manufacturers of those products to get off to a running start in the post-war market place. Those people who did not participate in military or essential civilian business found that many channels of distribution were already filled when supplies of raw material freed to the point where the late-comers could enter the race for fast growing markets. Also, in many cases, late comers could not get materials for their expansion.

In 1954, there were two proven suppliers of high molecular weight polyethylene resins and compounds. Within the near future, there will be 8 to 10 suppliers. Historically, there are many precedents to substantiate the statement that the increased competition for your business will speed progress. You will benefit from improved products, and the much greater emphasis placed on development of new uses. It is possible, also, that you will benefit from price reductions in your polyethylene raw materials.

In 1953, industry sales of polyethylene were about 140 million pounds. In 1954, industry sales exceeded 200 million pounds, an increase of about 50%.

Greater production from the two older producers combined with capacity from the new manufacturers could permit sales to exceed 300 million pounds in 1955. Publicized intentions of all the resin producers indicates that capacity will exceed 600 million pounds in 1957. This represents a production capacity 200 or 300 percent greater than industry sales in 1954. Such an increasing supply presents a real challenge to resin makers and users alike. It raises the question of our industry's ability to make products and sell them at that rate. The markets are there. How we go about developing them, tooling up and selling them, will provide the answer as to how well this industry can capitalize on this opportunity. We have talked about markets—let us take a look at them.

Table I shows the seven major end uses for polyethylene resins and compounds. It is obvious immediately that one of the most widely discussed uses, squeeze bottles, is small in total when compared with other less publicized end uses.

To see where and how growth can occur, let us take a closer look at each major use. For polyethylene bottle prospects, we can examine the glass and metal tube industries. The Department of Commerce and its Bureau of Census provides figures on glass container and collapsible metal tube sales. If glass bottle categories like milk, wines, liquor, and soft drinks are eliminated, figures are obtained on established glass bottle and jar markets that could be regarded as the total potential for polyethylene bottles. However, such figures would not be a true prospect, since we know that the glass industry will not sit idly by and watch their markets slip away. In addition, we must recognize that there are many products that cannot be packed satisfactorily in polyethylene due to its permeability to essential oils, its inability to retain a vacuum or to withstand sterilization temperatures. Also, polyethylene is likely to remain more costly than glass. When the total

Table I

MILLIONS OF POUNDS

	1954	1955
Bottles	10	13
Coatings	18	23
Film	75	105
Molding	33	40
Pipe	30	36
Wax	6	8
Wire	40	44
	212	269

potential figures are reduced to correct for these limitations and conditions, the resulting prospect is still exciting and explains the interest displayed by the glass and metal tube companies watching our industry's progress in reducing manufacturing costs, increasing output rates and improving end-product performance. While many factors influence any arbitrary selection of a potential figure for polyethylene bottles, the following figures give a rough measure of where polyethylene might grow in volume in bottle and collapsible tube applications.

Toiletries—Cosmetics	**10 million lbs.**
Medicinal—Drug	**16 million lbs.**
Chemical—Industrial	**20 million lbs.**
Food	**2 million lbs.**
Tubes	**2 million lbs.**

Total Prospect for Bottles, Tubes and Jars 59 million lbs.

The next major use category is coatings, which are applied by extrusion of a flat film immediately followed by lamination to papers, boards, fabrics, metal foils or other plastic films. Important applications involve military and industrial barrier wraps, multiwall and single ply shipping bags and sacks, a wide variety of food packaging materials of flexible and board types, food freezer and locker wraps as well as many miscellaneous uses. The Bureau of the Census helps us again to anticipate where this segment of our industry could grow by collecting and publishing elaborate statistics on the paper, board and allied industries. In addition, data on wax, asphalt, aluminum foil and other protective packaging raw materials are available. It is possible to make an analysis of cost vs. performance of competing materials. Limitations of present polyethylene resins, their processing and fabricating characteristics and shortcomings of the coated products in comparison with competitive materials impose obvious restrictions on how far polyethylene coated products can grow into known uses. When such an analysis is made, a prospect for 55-60 million pounds of polyethylene seems likely. It is worthwhile to note that manufacturers who are performing polyethylene coating operations include some of the largest paper manufacturers and converters in the country, such as St. Regis Paper Company, International Paper, Union Bag and Paper Company and many others. This is one characteristic of the polyethylene market that causes it to differ from some of our other plastics materials—the size of the consuming companies.

The end-use that is most difficult to predict accurately is film. It is difficult to predict mainly because new large volume uses are uncovered weekly. Admittedly, many new uses take a few years to become established, but the fact that they continue to be found confuses any forecast. It is easy to look at the 300 million pound per year cellophane market and predict that it will fall into polyethylene's lap when polyethylene film price drops to 50c per pound and below. Such predictions overlook the fact that over 75% of cellophane is converted on overwrap type of machinery in which polyethylene film does not handle easily due to that film's extreme limpness, narrow heat-sealing temperature range and sticky nature when hot. However, there are many clear cut areas where polyethylene film performs ideally. The list is long and includes such general applications as fresh vegetables and fruit, can, box and drum liners, crude rubber wrapping and camel back release sheets, frozen foods, poultry, a wide variety of miscellaneous food products, textiles and soft goods, hardware, closet accessories, and other categories that involve such uses as tarpaulins, automotive protective seat covers, moisture barriers in building construction, irrigation ditch liners, swimming pool covers, weather balloons, etc. After tabulating the potential volume prospects in these and many other uses, you have a figure which, if it could be sold, would account by itself for all of the proposed resin production capacity. After qualifying the figures with a realization of product deficiencies, competitive factors and developments such as polyethylene terephthalate, a potential of 300 million pounds appears to be possible of attainment in the foreseeable future.

Molding is an area of greater familiarity to S.P.E. members than most of the applications consuming polyethylene. The fact that polyethylene is being used in increasing quantities in housewares, packaging and toys is well known. Also familiar are the fully automatic molding of shoe counters, shot gun shell wadding, closures and many other items. The main point that can be made today is that polyethylene represents a promising opportunity for finding new proprietary and custom molded applications. Its ease of processing suggests comparatively trouble free plant operation with resultant higher profits. Progressive molders will watch for new opportunities to use this versatile material to be at the head of the parade of molders with diversified polyethylene experience who can guarantee uniform high quality at a fair price. Molding can become the second largest use for polyethylene with total annual volume in excess of 100 million pounds.

Pipe has been a much talked about end use for polyethylene, particularly since many of the steel and non-ferrous pipe manufacturers are setting up to make it. The forecasts for this use may be conservative, but future prospects exist for close to 65 million pounds in such general use classifications as farm and rural water distribution, wells, mine drainage, sprinkler systems, public water service, industrial and many miscellaneous applications. Limitations restricting use of polyethylene are its low temperature softening point, and relatively low tensile strength. An improved product that would permit use of polyethylene at temperatures close to 200°F. and at pressures in excess of 150 psi would substantially broaden its market prospects. Most pipe extruders will agree that the ideal fitting for polyethylene pipe has yet to be developed. Fittings represent a potential market for over a million pounds of molding compound.

Polyethylene is used as an additive to wax to upgrade its properties, such as gloss, scuff resistance, low temperature flexibility and heat seal strength. While the wax market is tremendous in size with annual consumption close to a billion pounds, polyethylene additives are used in only limited areas and in very low percentages, usually under 5%. The most well known uses include bread and frozen food box wrappers. Considerable development work is being done in this field, which could readily create markets to surpass a forecast of 15 million pounds.

Last, but far from least in importance of the major uses for polyethylene, are the wire and cable applications. Insulation for radar and other high frequency cables was the justification of the Navy Department to build the first polyethylene plants in this country during World War II. The industry has made tremendous strides in adapting this excellent insulating material to uses requiring low loss insulation, light weight, water resistance and good weathering properties. Well established uses include telephone cable jacketing, TV lead-in wire, a variety of power line wire and cable constructions, coaxial cables, signal and control cables, military communications,

submarine cables and many others. In 1953 a major proportion of the polyethylene wire and cable applications moved into military channels. Anticipating that ample raw material would be available, industry sought civilian applications that would benefit from the use of polyethylene. In 1954 with military needs reduced, civilian developments barely maintained the industry's consumption level of the previous year. Civilian uses are catching hold and the industry is moving steadily ahead. Foreseeable future use could reach 60 million pounds. A significant increase in heat resistance of polyethylene would assure achievement of this prospect.

When these forecasts are added together, it appears that sometime late in this decade, or certainly by the early 1960's, applications will demand the polymer capacity that is now building or projected. While it is quite possible that the timing of these predictions could move ahead or backwards a few years, the markets are there. It is the responsibility of the resin producers to improve constantly the quality and range of properties in polyethylene resins and compounds to provide the users with the raw materials that they will need to meet the requirements of these markets. Machinery producers must find ways to make major increases in productivity. Molders and converters must develop new levels of quality and cost to go with the new machinery. Some reporters have expressed fear that capital equipment cannot be made available at a fast enough rate to meet the demand. There appears to be an adequate supply of dollars. There may be a question on the quantity of engineering and production talent, a situation that concerns all technological industries.

To help allay any doubts that this industry can and does develop rapidly and with good and sound justification, let me cite a few examples:

Polyethylene baby bottles were unheard of in 1953. They were bottle industry's hottest item in 1954, with better than 20 million units produced. This volume could jump another 50% in 1955. While the bottles are not recommended for sterilizing exposures, they are much easier for the baby to handle due to their light weight. When dropped they do not break or chip. This remarkable growth was achieved despite a higher retail cost to the consumer.

A package for pipe tobacco, involving a polyethylene coating on aluminum foil as the heat sealing moisture barrier on the pouch, costs ⅓ less than the metal can used previously. The tobacco's moisture and flavor content is retained to give more product protection. The package is more convenient. It makes a better display with increased impulse sales appeal. It provides much better shelf life. The manufacturer was able to open up new territories due to the longer shipping distances that resulted from greater shelf life and increased product protection.

A progressive chain of super markets in Springfield, Mass., were selling fresh fruit and vegetables in polyethylene bags last spring at a rate that if applied to all markets of a comparable size would have consumed 2 million pounds of film per week. Obviously, this is not a valid extrapolation, but it is an exciting figure. One chain of super markets in Minnesota went to 100% produce prepackaging. This is how they benefited:

Average gross margin on produce increased from 22 or 23% to 30%.

Produce percentage of total store sales moved from 9 or 10% to 11-12%.

Spoilage and markdown losses were cut from between 5-7% to 2% or less.

Labor expense dropped as much as 4%.

In another local Springfield super market 10 pounds of washed potatoes in a polyethylene bag were outselling the same potatoes unwashed in a paper bag more than 3 to 1 despite a price disadvantage of 5c per bag. If half of the State of Maine's crop of potatoes were packaged in polyethylene, 80 million bags would be required, involving 2½ million pounds of film. You can anticipate the near future day when all of the heavy crops are packaged in polyethylene bags by the grower.

A polyethylene drill box costs 35% less than its metal counterpart and weighs 52% less. The package is neater, more attractive, more durable, fits the pocket easily without tearing the fabric. In addition, it gives the drills more protection against damage in case the box is accidentally dropped on a cement floor. The clincher—the package is selling more drills.

The polyethylene shoe counter has been widely publicized. In an industry where fractions of a penny are important in the cost of a pair of shoes, the polyethylene counter may add 5c per pair. However, it provides durability and better shoe appearance throughout a likely longer life. In addition, the polyethylene counters provide a strong selling point to the mothers of America who see their shoe dollars flying away, every time the youngsters jam their feet into tied shoes, thus breaking down the heel.

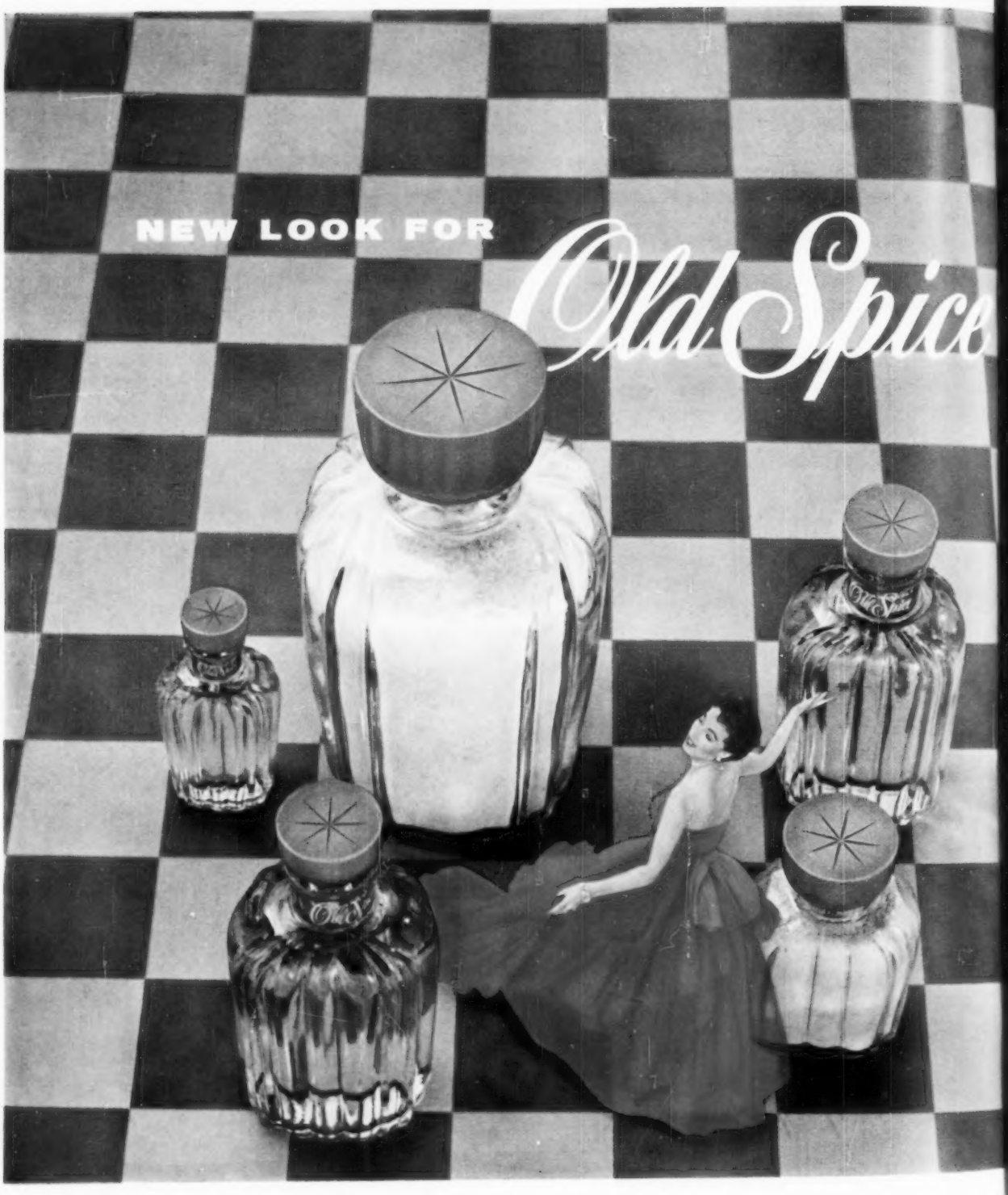
There is a possibility that a substantial percentage of the one trip steel drums and pails made in this country will use this or a similar polyethylene bung and plug within five years. Over 100 million drums and pails were made and sold in 1953, each with one or more bungs and plugs.

Polyethylene pipe has saturated the mine drainage and jet well applications. While mining may trend downwards, there is every expectation that the number of wells drilled per year will continue to increase. A polyethylene well installation can be made in a few hours by one or two men. To sink a well using metal pipe requires a tripod, a crew of 3 or more men and the better part of a day. Is it any wonder why a farmer buys 100 to 400 feet of coiled polyethylene pipe to unroll into a plow furrow when he wishes to supply water to a new spot on his acreage. Think of the millions of proud homeowners who are prospects for a $20-$40 per 100 feet sprinkler system that they can install with ease themselves and never worry again about moving hoses, getting wet feet, or having an unmoved hose kill the grass underneath it. Golf courses, parks and cemeteries save watering costs with such permanent installations.

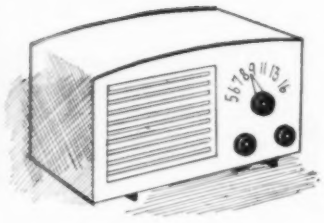
The wax additive market is somewhat outside the molder's normal interests. However, you need only to compare two wax bread wrappers to understand why your wife is likely to pick the one containing polyethylene due to its fresher appearance and brighter colors. Low molecular weight polyethylene resins of the type used as wax additives are being promoted also as plasticizing aids in vinyls. All conventional applications for petroleums and vegetable waxes are being investigated as prospects for polyethylene. It would take only one good use to pass the figure forecasted in this category.

Wire applications are interesting because polyethylene is replacing lead, rubber, paper, varnished cambric and other time proven insulating and jacketing materials. Polyethylene is the only insulating material at practical cost for radio and higher frequency television and communication wires and cables. Its use in high voltage power

(Please turn to page 36)

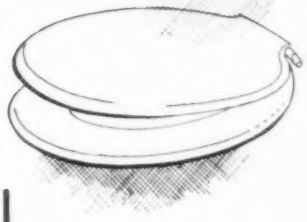


PLASKON® Urea . . . le

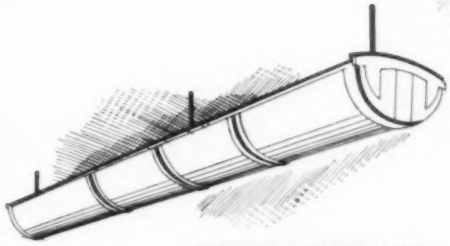


DURABILITY

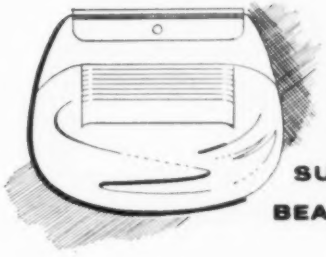
STRENGTH AND SURFACE HARDNESS



ELECTRICAL PROPERTIES



TRANSLUCENCY



SURFACE BEAUTY

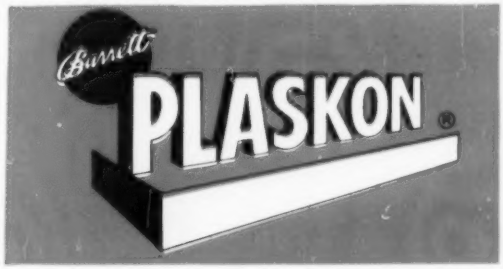
To give their "Old Spice" toiletries an extra sales lift, Shulton, Inc., decided to revamp its packages. The new design called for thermo-setting "reverse taper" bottle closures—a tough molding job at best.

The molder selected PLASKON Urea Molding Compound for the job. Why PLASKON Urea? Because this versatile material molded well in the varying cross sections and contours of the Old Spice closure, and its rapid rate of cure permitted higher-volume, lower-cost, top quality production.

This is another instance where PLASKON Urea has simplified a molding job. Why not find out if it can do the same for you? Your Plaskon man stands ready to furnish you with complete data and technical assistance on all your molding problems.

Glowing surface beauty and a range of over 13,000 molded-in colors make PLASKON Urea highly suitable for closures, radio and TV cabinets and hundreds of other products.

PLASKON Urea has high dielectric strength and arc resistance. That's why it's ideal for use in wall plates, sockets and electrical appliances such as shavers, clocks and lamps. The surface is very hard, scratch-resistant and easy to clean.



If you'd like more information on PLASKON Plastics and Resins, write or call: Barrett Division, Allied Chemical & Dye Corporation, 40 Rector St., New York 6, N. Y.—HAnover 2-7300.

Allied Chemical

... leader in the field

Recent Advances in . . .

Isocyanate Resins

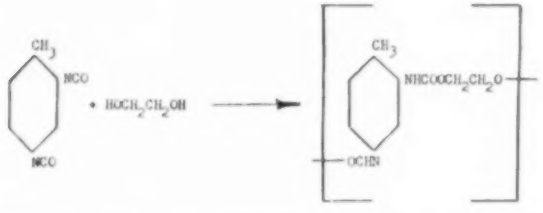
Irving Katz
Research Engineer
North American Aviation, Inc.

The isocyanate-base polymers are a relatively new class of materials structurally similar to nylon. In fact, soon after the development of nylon by duPont became known, I. G. Farben of Germany attempted to develop similar or better materials. On November 11, 1937, they announced the results of their research on the addition of isocyanates to hydroxy, amino and carboxyl compounds. From that time on, the initial German developments have mushroomed into many fields including adhesives, foam-in-place expanding resins, molding compounds, elastomers, textiles and protective coatings.

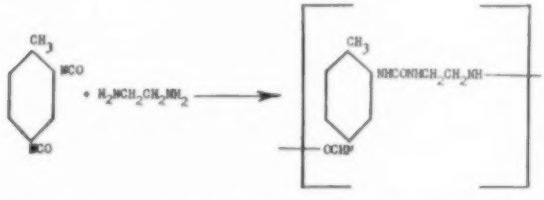
The American activities with the isocyanates prior to the last war were limited. However, after the distribution of numerous reports prepared from the details gathered at German industrial organizations by Allied teams of scientists and engineers, the isocyanate-base polymers took on interest in this country.

THREE DISTINCT CLASSES of isocyanate-base polymers can be prepared. They are: polyurethanes, polyureas, polyamides.

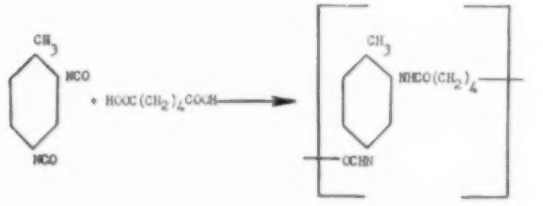
The polyurethanes are prepared by treating polyhydroxy compounds with polyisocyanates — for example, meta-toluene diisocyanate and ethylene glycol.



The polyureas are prepared by treating polyamino compounds with polyisocyanates — for example, meta-toluene diisocyanate and ethylene diamine.



The polyamides are prepared by treating polycarboxylic acids with polyisocyanates — for example, meta-toluene diisocyanate and adipic acid.



Each of these classes of materials has certain intriguing attributes that have made them attractive. Table I compares some of the generalized properties of the three classes of polymers prepared by the isocyanate method.

Although interest in isocyanates is relatively recent, increasing numbers of development programs are being undertaken to investigate the provocative properties offered by the isocyanates. It is the object of this paper to review a selected few of these developments.

Elastomers

In the rubber field, two new isocyanate-base elastomers are being developed. They are the isocyanate-modified polyesters and the internally plasticized polyurethanes.

ISOCYANATE-MODIFIED POLYESTERS

Isocyanate-modified polyesters demonstrate unusual abrasion resistance. They are manufactured by a three-step process. The first consists of preparing a hydroxy-rich polyester by treating polycarboxylic acids with excess

Table I

Generalized Properties of Isocyanate-base Polymers

	Polyurethanes	Polyureas	Polyamides
Cure	Room Temp. (Intermediate)	Room Temp. (Fastest)	Room Temp. (Slowest)
Moisture Absorption	Lowest	Highest	Intermediate
Melting Point	Lowest	Highest	Intermediate
Flexibility	Highest	Lowest	Intermediate
Chemical Condition	Thermoplastic or Thermosetting		
Polymerization By-products	None	None	Carbon Dioxide

polyhydroxy compounds. The second consists of lengthening these polyester chain molecules via polyurethane linkages by treating with excess polyisocyanates. The third consists of vulcanizing the isocyanate-rich polyurethane-lengthened polyesters by treatment with water, glycols, diamines or even further polyisocyanates.

The uncured rubber has a shelf life of several weeks, the length depending upon the concentration and type of ingredients. When compounded with the vulcanizing ingredients, the shelf life of the material is drastically reduced to approximately one day.

Since the shelf life is short fabricators are required to do their own compounding immediately prior to molding. Preliminary information indicates that the breakdown and compounding of the green rubber may be done in a Banbury and the addition of the final curing agents on a cool mill. Limited compounding information indicates, that (1) the addition of plasticizers acts only as quality diluents, (2) softening agents have a pronounced initial softening effect but tend to accelerate an undesirable hardening of the cured stock, and (3) carbon blacks do not improve toughness except in certain weak stocks. The compounded rubber has little or no building tack. Temporary tack, therefore, may be imparted by treating the stock with ketones such as acetone or methyl ethyl ketone.

The compounded rubber, additionally, has poor adhesive qualities. Successful bonding to other rubbers necessitates using blends of the isocyanate-base rubber and the elastomer to be bonded.

The vulcanized rubber demonstrates good resistance to abrasion, ozone and general weathering. It is flexible, has excellent oil resistance and is fairly resistant to dry heat. However, under moist conditions at elevated temperatures (212°) it undergoes rapid breakdown. It has poor resistance to aromatics, chlorinated hydrocarbons, ketones, substituted ammonium compounds, terpenes, acids and bases.

The material, in the form of coatings, shows promise for improving the wear resistance and general weathering characteristics of susceptible materials in applications requiring high abrasion resistance.

Some typical applications contemplated for the rubber per se include shoe sole and heel materials, hydraulic gaskets, oil seals and timing gear belts. Unfortunately, the high manufacturing costs prohibit any commercial realization for the present. It has nevertheless been conjectured that tires fabricated from these isocyanate-base rubbers having tread lives of 100,000 miles could be made at prices competitive to other rubber base tires of comparable road life.

INTERNALLY PLASTICIZED POLYURETHANES

On the other side of the isocyanate-base rubber program, internally plasticized polyurethanes are being developed as colorless, water white, transparent elastomers having extensibility, toughness, stability to light and heat, insensitivity to water, and good adhesive qualities.

Practice consists of taking mixtures of polyhydroxy compounds and hydroxy-rich plasticizers and copolymerizing them with pure isocyanates or isocyanate prepolymers. The reaction occurs at room temperature and is especially rapid at lower plasticized concentrations. The properties of the subsequent material are enhanced by short postcures. Standard casting techniques are satisfactory for processing these elastomers.

Varying the concentrations of plasticizers yields products ranging from hard, tough, horn-like solids to soft, tacky semi-solids. The higher plasticized materials are limited with respect to temperature. A modification using hydroxy-rich polyesters has improved the temperature resistance but on the other hand decreased the elastomeric qualities.

One requirement with the use of these materials is the necessity for the absence of moisture and acidic components, since these produce blistered products. The blistering stems from the carbon dioxide liberated from the reaction between the isocyanates and water and/or acids.

One outstanding mechanical property of these elastomers is their great affinity for glass. Certain compositions bond so firmly that under load the glass fails rather than the bond.

The optical properties of the cured polymer are in part dependent upon the initial color of the reactants. Tinted monomers will produce tinted polymers. Consequently, purification is a prime requisite. The extent of purification will be one of the prime factors in defining the future costs of the material.

At present these materials show promise as specialty casting resins, as optical cements, and as interlayers for specialized safety glass applications.

Adhesives

Ten years ago the possibility of structurally bonding materials one to another with a low-temperature, rapidly-curing adhesive was virtually unheard of. Yet through the innovation of the isocyanate such bonding can be effected.

There are three basic types of isocyanate adhesives which, for want of better names, can be classified as follows: (1) the polyurethanes; (2) the hybrid polyurethane-polyureas; (3) the polyisocyanates.

POLYURETHANES

The polyurethane adhesives are generally prepared only by a fabricator at the time of assembly, since their pot life is limited. Practice consists in mixing weighed, essentially stoichmetric amounts of polyisocyanates or prepolymer isocyanates with polyhydroxy compounds, applying to the surfaces of the adherends before the viscosity of the mix becomes excessively high, assembling, and allowing to cure at room temperature under contact pressure, although certain compositions may benefit from an afterbake under pressure.

A modification to provide some latitude with respect to pot life employs solvents such as acetone or methyl ethyl ketone. A drying period coupled with a higher temperature cure is necessary.

This type of adhesive, although having the desirable attributes of rapid low temperature curing without any polymerization by-products, necessitates operating personnel to handle the active isocyanate, make fairly accurate weighings, and to operate under rapid production schedules in order to adhesive-bond materials successfully. In spite of this, this type of adhesive system can be used for general purpose bonding and has shown some promise for metal-to-metal bonding in extreme low-temperature applications.

HYBRID POLYURETHANE-POLYUREAS

The hybrid polyurethane-polyurea adhesives are more appealing since they have considerably longer pot life than the straight polyurethane adhesives. Resin manufacturers can prepare the adhesives, ship it to a fabricator, whereupon the latter may use it at varying times of demand without the necessity of handling the potentially dangerous pure isocyanate, the bother of weighing out

ingredients or the maintenance of tight production scheduling.

These adhesives are prepared by treating polyhydroxy compounds with an excess of polyisocyanates to yield isocyanate-rich polyurethanes. The adhesive manufacturer at this point may add a catalyst directly to the adhesive to speed the subsequent curing operation. This isocyanate active polyurethane undergoes crosslinking in the hands of the fabricator when allowed to stand in air. The moisture in the air converts a portion of the excess isocyanates into amines. The carbon dioxide liberated escapes more or less readily from the open-face adhesive treated adherends. The amines react immediately with the excess isocyanates to yield polyureas, which in turn crosslink the adhesive by reacting with the remaining isocyanate.

Addition of a solvent provides a lower viscosity adhesive, allowing more ready release of the carbon dioxide, but indications are that the shelf life of the adhesive is reduced.

The adhesive is applied to the surface of the adherends, left standing in air for a predetermined period, the parts assembled and then cured under pressure. Relatively short room temperature curing is permissible although some heating may be found desirable to gain optimum bond qualities.

These adhesives are easier to use than the straight polyurethane adhesives; however, considerable care must be exercised in their handling to prevent undue moisture contact, since premature gelation will occur. The adhesives are suitable for bonding practically any combination of materials.

Variations in the type and ratio of ingredients and catalysts provide bonds of differing mechanical and physical properties. As yet the standardization of basic formulations is in its infancy, and fabricators in most cases are required to develop their own formulations.

POLYISOCYANATES

The polyisocyanates alone or blended with elastomers have received considerable attention for bonding elastomers to metals and to fabrics. Previously the former bonds were effected by the brass plating technique, the ebonite layer technique, and more recently by adhesives based on rubber derivatives. Present development work has indicated that the polyisocyanates may provide more versatile adhesives than any of the above, since (1) they are capable of bonding practically any combination of elastomers to metals and to fabrics (2) are easily applied, (3) have good oil and solvent resistance, and (4) yield good mechanical properties.

Bonding is effected with the non-modified polyisocyanate adhesives in a manner analogous to that used with the hybrid polyurethane-polyurea adhesives. The curing mechanism is essentially the same.

The length of open-face standing period and the ambient humidity affect the strength of the bond. Preliminary tests indicate that the bonding should be performed within a relatively short time, say in the order of hours (see figures 1 & 2). To relieve the tight production scheduling, cover cements of the elastomer to be bonded can be applied to the polyisocyanate adhesive treated metal panels. Additionally, blends of polyisocyanates and elastomers, rather than the unmodified polyisocyanate, may be applied to the surface of the metal, to lengthen the open-face storage life. However, the blends themselves have a shelf life limited to generally one week. Solvents under certain conditions may be added to improve the stability.

The bonding of elastomers to fabrics can be effected

Figure 1. Effect on adhesion of humidity during storage of MDI-50 coated steel disks. (From DuPont Bulletin 241.)

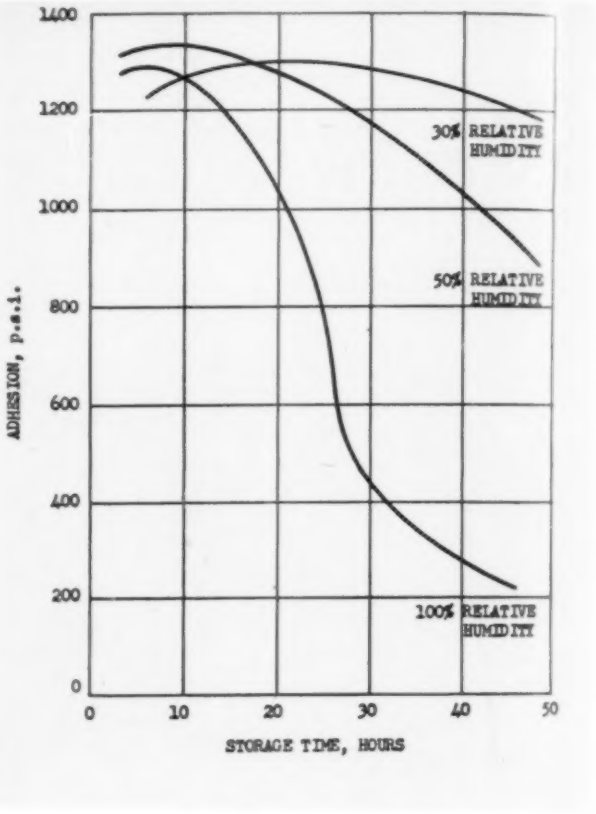
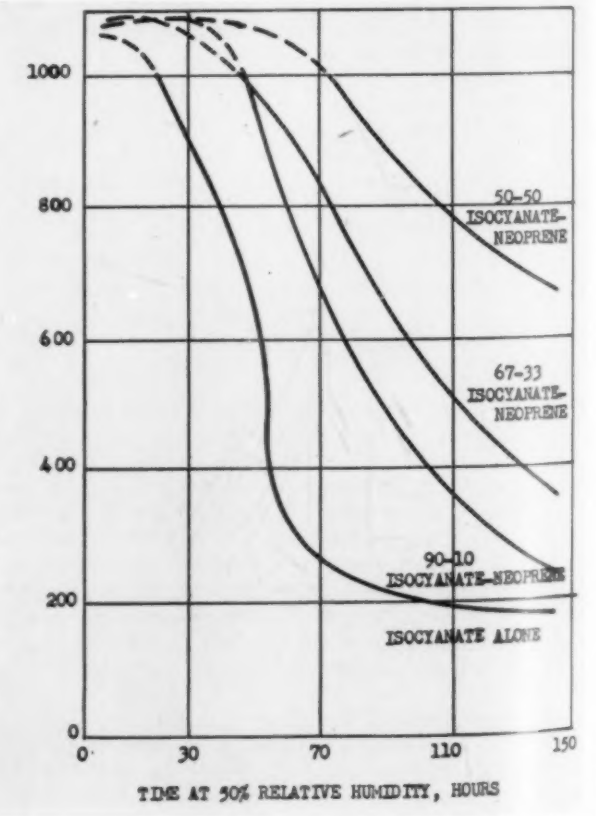


Figure 2. Effect on adhesion of time of storage of isocyanate-neoprene adhesive blends coated on steel disks. (From DuPont Bulletin 241.)



with dilute solutions of various elastomers modified with polyisocyanates. A fabric is coated by any convenient means with the isocyanate-elastomer cement, the solvent allowed to evaporate, the elastomer applied to the coated fabric, and then cured under contact pressure by a predetermined vulcanization method. The isocyanate-elastomer cements are prepared by breaking down the rubber on a rubber mill, preferably using a peptizing agent, dissolving the masticated rubber in a solvent and adding the isocyanate. Generally, the cement is stored for a few hours at room temperature prior to use. Unfortunately, since the pot life is limited to about one week, the fabricator is required to formulate his own adhesive.

These isocyanate adhesives provide bonds having excellent flex resistance that do not undergo heat generation on flexing.

Potting Compounds

Plastics are being sought for electrical applications that have the following desirable basic properties:

1. Low water permeability
2. Low shrinkage
3. Stability under wide temperature ranges
4. Good mechanical properties
5. Elastomeric properties
6. Good chemical resistance, especially against ionic type impurities (e.g., salt water)

Specific electrical applications may dictate the necessity for materials having diverse electrical properties. A plastic having greater universal appeal would be one having a low dielectric constant and dissipation factor but a high dielectric strength and resistivity, because these properties can be readily increased and decreased, respectively, for a particular application by the addition of fillers and modifiers and, less readily, by altering the chemical nature of the resin. On the other hand, plastics having a high dielectric constant and dissipation factor and low dielectric strength and resistivity would not be desirable because these could not be changed without major modifications.

It is recognized that for isocyanate-base polymers undesirable electrical properties from the above viewpoint may be imparted by virtue of the polar reacted isocyanate linkages and, additionally, by any other polar linkages. Therefore, in order to reduce the polarity to a minimum, the length between the polar linkages for a given degree of polymerization should be increased.

Castor oil suggests itself as one possible compounding ingredient for accomplishing this. Additionally, it contains three active reaction positions capable of producing thermo-setting polymers (if all are utilized) which assures better chemical and thermal properties basic to thermo-setting polymers and it imparts elastomeric properties by internal plasticization, assuring long life without the possibility of the plasticizer exuding.

At present, castor oil modified polyurethanes have been developed that are satisfactory transformer potting compounds. They conform to the requirements of MIL-T-27 for transformers. However, they may not be satisfactory for high frequency potting applications where a dielectric less than 3.5-4.0 is required. On the other hand, they are potentially suitable in high frequency applications as phase shifters within wave guides in radar sets. They can, by increasing the loss factor, be made suitable for terminating microwave power such as termination or dummy loading.

Greases

With increases in speed and temperature of modern machinery and aircraft, a need was anticipated for a grease that would operate over wider temperature ranges and mechanical loads than those of presently available products.

The requirements for a good elevated-temperature resistant grease are listed below:

1. It does not melt, harden, or darken excessively at the elevated temperatures.
2. The viscosity does not increase excessively at low temperature.
3. It should have good mechanical stability throughout the temperature range intended.
4. The evaporation and leakage losses should be low.

A grease consists generally of a thickener, fluid, and additives. Since silicones have excellent temperature resistance and good lubricity qualities, it is natural to use them as the base for temperature-resistant greases even though they are known to have poor wearing qualities.

Present investigation with both inorganic and organic thickeners indicates that the isocyanate-base ureas show the most promise for producing a high temperature-resistant grease. The development work has shown so far that silicone oils thickened with ureas are stable and have good rheological properties, but suffer from poor wear and poor low temperature properties.

The feasibility of preparing the urea thickener in the oil itself (1) produces a uniform thickener particle size tending to reduce the concentration necessary and (2) makes attractive their method of manufacture from a production stand-point.

The amides do not give as desirable properties as do the ureas, while insufficient data still exist for the urethanes.

Rocket Propellants

A solid propellant consists of an oxidizer, a fuel and burning rate regulators. The fuel is generally a resin, since this permits safer handling of the oxidizer (a highly combustible material) and allows the mix to be cast or extruded readily into the final firing shape.

The requirements for a satisfactory resin for propellant purposes are:

1. A high hydrogen to carbon ratio providing higher heats of combustion.
2. Low viscosity, permitting easy mixing.
3. Low exotherm and low temperature curing to prevent possible detonation of the oxidizer.
4. Sufficient pot life to enable reasonable working time.
5. Low moisture absorption and low temperature flexibility to prevent cracking of propellant at reduced temperatures.
6. Non-corrosive and low molecular weight gases given off to prevent possible damage to aircraft wings and to provide better thrust.
7. Good aging characteristics to prevent cracking.

The polyurethanes properly modified provide most of the above requirements. It is not surprising, therefore, to find that they are being investigated for such purposes. Two shortcomings, however, have been encountered, these are poor loading characteristics and short pot life. Presumably by modification with plasticizers and/or copolymerization, these shortcomings should be overcome.

Expanded Plastics

One requirement that plagues fabricators using isocyanate-base polymers is the necessity for maintaining anhydrous and non-acidic conditions in order to produce void-free products. However, a remarkable phenomenon occurs when judicious quantities of acid and/or water are

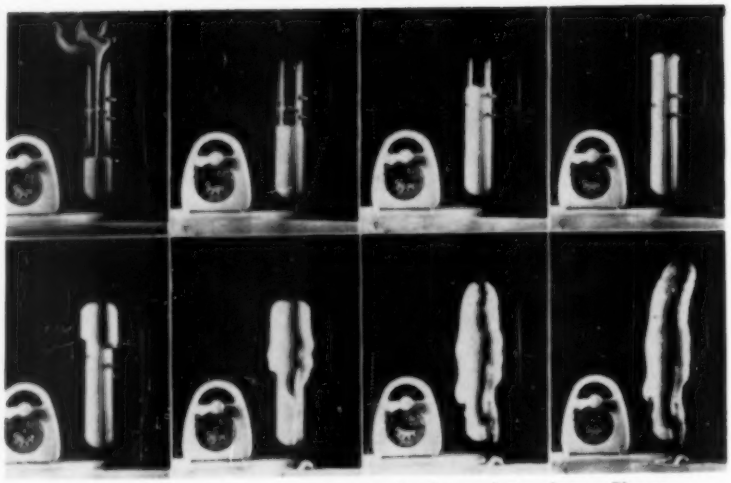


Figure 3. Isocyanate-base resin can be foamed in place. Photos courtesy of Lockheed Aircraft Corp.

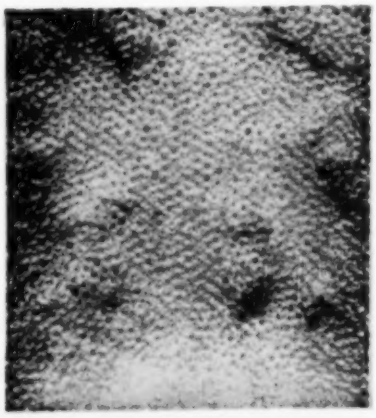
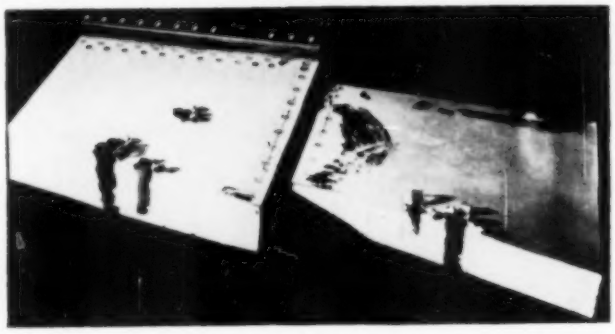


Figure 4. Cell structure of expanded isocyanate resin. (Nopco Chem. Co.)

Figure 5. (Below) Bullets do not break skin-to-core bond. (Lockheed Aircraft Photo.)



deliberately added to certain isocyanate-base polymers. The resin undergoes a considerable increase in volume during cure, sometimes as high as thirty-fold, to yield a plastic composed of a multitude of randomly distributed encapsulated gaseous cells (see figures 3 & 4). This expanded plastic product has resilience, low density and good mechanical, electrical and heat insulation properties.

This phenomenon of expansion has become the basis of the only isocyanate-base products to attain true commercial realization. These products are called "foam-in-place, expanding resins."

The mechanism for foaming is a two-step process. The isocyanate-rich material reacts with water, liberating carbon dioxide and forming polyurea linkages which upon further reaction with the excess isocyanates crosslinks the resin. As the reaction continues, the viscosity of the mix increases, while the entrapped carbon dioxide swells the mass. Apparent termination occurs when the concentration of the isocyanate is exhausted. The amount of bubbling can be controlled by the amount of isocyanate and other chemical modifying agents, thus giving products of varying but controllable and uniform densities. The foamed plastic can be made having a majority of either open cells or closed cells. Additionally, by varying the initial reactants, products varying from soft flexible materials to hard rigid materials of comparable densities can be prepared.

Since foaming-in-place is essentially a tailoring operation, products of varying foaming speeds and attainable densities are necessary to permit fabrication without the necessity of excessive development work.

Practice is limited to two types of operations. In the first the resin is prefoamed and then used in a subsequent assembly e.g., in certain sandwich constructions, and in the second the resin is expanded directly within the assembly itself, e.g., in encapsulation of electronic components. The former necessitates using a parting agent which may be chosen from paraffins and mineral oil or by lining the mold with polyethylene.

In the case of foaming-in-place, where bonding to the part is a necessity, some improvement in bond strength can be achieved by flushing the part with isocyanates, although in most cases bonding should not present any problem (see figure 5). In fact, cases have been reported where good bonds have been achieved even when foaming against damp surfaces.

Generally most of the commercially available foaming resins require no preheating, unless stored under reduced temperature, and in these cases the preheating would be solely for the purpose of returning the product to room temperature.

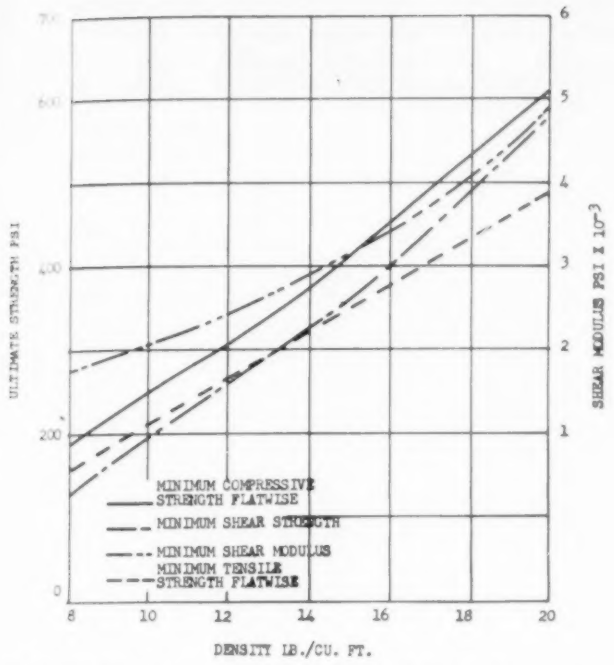
The required amount of foaming resin for an application is determined by multiplying the volume to be filled by the density of the expanded plastic anticipated and then adding 10% extra material as a safety factor to insure complete filling. One manufacturer has suggested that no more than 10 pounds of material be processed at any one time. Volumes larger than that which can ordinarily be handled with 10 pounds of the mixture can be filled in a series of foaming operations.

The chemicals may be mixed in any suitable container; throwaway containers are preferred to avoid the bother of cleaning operations. Mixing by hand or mechanical agitation is suitable; the size of the batch determines the method. The length of mixing is ordinarily no longer than one minute. However, certain compositions may permit shorter or longer mixing periods. The reaction starts as soon as the chemicals are mixed. Where large quantities are handled, pressure injection of the activated mass into the part may be necessary.

In certain applications the foaming plastic may be sprayed from a dual container spray gun. The mixing of resin and catalyst occurs during atomization. Flat objects have been sprayed with a 1/16 to 1/8 inch layer of activated resin at a rate of three board feet per minute to yield a foamed insulation of about one inch thickness. Multiple coatings can be achieved by repeated sprayings, each spraying operation being performed after intervals of about 30 minutes.

The expanded plastic generally hardens within a few hours; maximum structural strength is usually achieved within 24 hours. There are, however, compositions which require postcuring to attain optimum strength. These materials are generally the high strength foamed plastics.

The foam-in-place expanded plastics are finding more use in applications as their attractive properties are becoming known. For example, the rigid foams are being used in the aircraft industry (see figure 6) in sandwich type constructions to provide extra shear stabilization. This



Mil-C-8087 (USAF) requirements, Fig. 6. (above) for average mechanical strength for foamed-in-place Core material tested in sandwich form. Fig. 7. (upper right) for electrical properties of foamed-in-place core. Fig. 8 (opposite) for average water absorption of core material, total immersion for 24 hou.s.

Figure 9. Increase in boundary layer temperature with speed. (From Hibbard and McBrearty, "Western Aviation," Oct., 1953.)

permits stresses to crippling loads closely approaching the yield of the skin material itself.

In applications where electronic equipment (see figures 7 & 8) will undergo severe vibrational shocks, encapsulation of the entire apparatus in an expanded plastic usually provides the necessary protection. Flexible foams are being investigated in this connection.

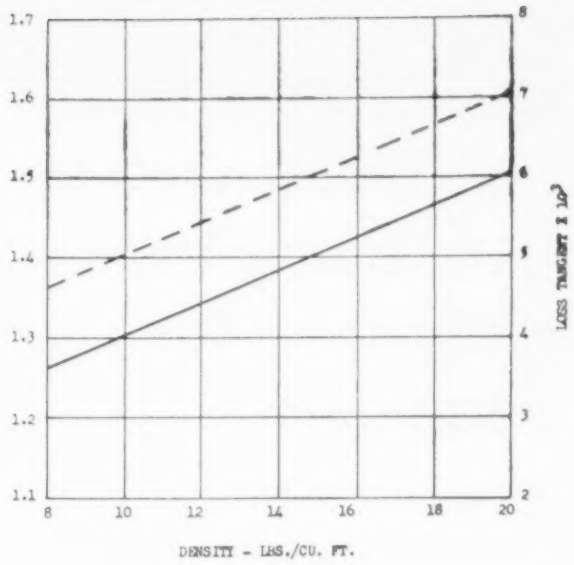
The European-manufactured isocyanate-base foams are being used as inter-liners in winter clothing, taking advantage of the material's good insulating properties. Other development work attempting to utilize its good heat insulating properties is finding application in construction of refrigerator truck bodies.

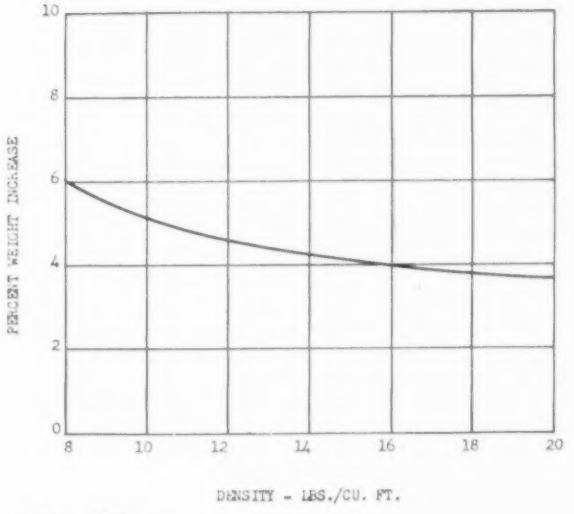
Isocyanate sponge material (open cell), which is approximately one-half the weight of foam rubber of equal volume, is finding application as carpet underlays, shoulder pads, and furniture padding. The seating qualities of isocyanate sponge resemble those of feather cushions with respect to compression recovery. It is slower than comparable foam rubber cushions.

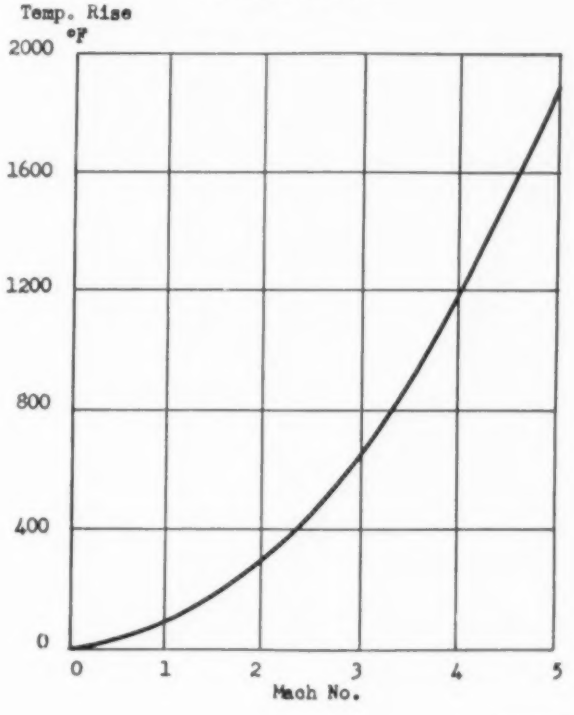
Isocyanate cleaning sponges do not demonstrate the same take up of water as do the cellulosic or natural sponges. But, on the other hand, being tougher and more abrasion resistant, they outlast cellulose sponges by many times.

Heat-Resistant Plastics

The needs of modern industry for materials having wider temperature resistance are becoming increasingly evident. For example, in the air-frame business, aircraft are attaining speeds which generate temperatures approaching 500 F. by virtue of air friction alone (see figure 9).







Certainly these temperatures limit the choice of materials—in the case of plastics, drastically. Since many applications require the properties only found in organic and semi-organic materials (e.g., elastomeric properties), considerable research and development work is being undertaken to develop elevated-temperature-resistant plastics and elastomers.

Of prime interest for extreme temperature resistance are organic materials based on boron, silicon, and titanium. Only boron and silicon so far have been evaluated with respect to isocyanates.

Isocyanate-Treated Boron-Base Polymers

Boron has extreme temperature resistance but suffers from water sensitivity. Treatment of various boron compounds with isocyanates in some cases substantially reduces this water sensitivity.

Isocyanate treatment of boric acid, for example, has led to infusible, high-temperature-resistant polymers. Mixtures with monofunctional isocyanates, however, leads to fusible, partially water soluble materials.

Treatment of bifunctional boronic acids with bifunctional isocyanates yields white solids of very high softening points capable of being formed into films and fibers by either higher temperature extrusion or by means of solvents through conventional methods. They are soluble in phenol, formic acid, benzene and ether.

These compounds, the presumed polyboronamides, are capable of being converted into N-alkoxymethyl derivatives which show increased elastomeric properties. These polymers are also white solids but of lower softening points than the polyboronamides. They are soluble in alcohol, formic acid and acetic acid.

Some controversy has arisen in the last year or so concerning the exact composition of these polymers. The new contention is that the polyboronamides are nothing more than boron-containing polymers, the boron content probably being in the form of loosely bonded boric or boronic acids.

Nevertheless, whatever the exact composition, the product still melts in the order of 315-330°C. and is soluble in a goodly number of solvents.

ISOCYANATE-TREATED SILICON-BASE POLYMERS

The isocyanates have found utility with the silicones. One of the chief obstacles in using silicone resins is their thermoplasticity upon increasing the temperature.

Silicones prepared from silanediols treated with diisocyanates yield copolymers having decomposition temperatures in the order of 675-750°F. They are insoluble and infusible. Some adhesives prepared from these resins have demonstrated metal-to-metal bond strengths of approximately 500 psi at 500°F.

A new method for preparing cured polysiloxanes by relatively simple means consists of treating silicon-base polyisocyanates with silanols and then heat decomposing to yield a siloxane.

Another procedure for preparing high-temperature-resistant polymers is the treatment of carbon-base polyhydroxy compounds with silicon-base isocyanates. Products capable of withstanding temperatures in the order of 600F. and showing some promise of having elastomeric properties are produced.

Isocyanate-Base Catalysts

One detriment to the use of synthetic resin adhesives is the necessity of weighing predetermined quantities of resin and catalyst prior to use. Once catalyzed, the adhesive has a limited pot life. Therefore, relatively tight production schedules are necessary. One goal most fabricators seek is the adhesive operation in which a stable catalyzed resin can be applied to the faying surfaces of a part, assembled, and cured under slightly elevated temperatures; only heat would activate the catalyst to set the resin. Such a system is now feasible using the so-called isocyanate-generators. These are compounds that decompose under relatively low temperatures to liberate the active isocyanate and other reactant.

Epoxy resins are glycidyl ethers of polyhydroxy compounds and as such have hydroxy groups evenly spaced along the main chains. These polymers can be crosslinked through the hydroxy groups with isocyanates as well as through the terminal epoxy groups with nucleophilic agents. Thus, the base resin can be modified with an isocyanate-generator which would be a low temperature decomposable compound yielding an isocyanate and a nucleophilic agent. This mixture will be stable as long as the decomposition temperature of the generator is not exceeded. Considerable materials handling should be reduced by such a product.

Future Applications

To be sure, there are other isocyanate base products undergoing investigation. Protective coatings, textiles, molding compositions and, to a very limited extent, laminates are being affected by the versatile isocyanate.

However, the future of isocyanate-base and modified products will be determined by a number of factors, paramount among which are the following:

1. The cost of the base isocyanate.
2. The reluctance of industry to accept new processing operations inherent to the new materials unless definite advantages are offered.
3. The reluctance of industry to handle products having the ominous-sounding name of isocyanate-base.

Some advance has been made in reducing the cost of the base isocyanate and some with the increasing acceptance of the foam-in-place expanding resins. In time, no doubt, these materials will probably follow the same process of evolution that the more common plastics have undergone to attain their position in industry.

Table II

Sources of Supply (U. S.) for Isocyanates

The Garvin Company, North Haven, Connecticut
E. I. duPont deNemours & Company, Inc., Wilmington 98, Delaware
Mobay Chemical Company, St. Louis, Missouri
Monsanto Chemical Company, St. Louis, Missouri
National Aniline Division, Allied Chemical & Dye Corporation, New York, N. Y.

Table III

Sources of Supply (U. S.) for Isocyanate-Base Resins

Adhesives:

E. I. duPont deNemours & Company, Inc., Wilmington, Delaware
Monsanto Chemical Company, St. Louis, Missouri

Elastomers:

Goodyear Tire & Rubber Co., Akron, Ohio

Foaming-in-Place Resins:

American Collo Corporation, New York, N. Y.
American Latex Products Company, Hawthorne, California

(Please turn to page 38)

Find out today how
STYRON 475 SHEET
can make money for you!

Plastics Sales Department, Dept. PL 490JJ,
The Dow Chemical Company, Midland, Michigan.

DOW

Please rush technical data on Styron 475 sheet and nearest source of supply:

Name and title_____

Firm name_____

Types of product manufactured_____

Address_____

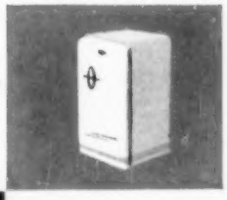
City_____ Zone____ State_____

HIGH FABRICATION COSTS A PROBLEM?

Dow has the answer in

STYRON 475 PLASTIC SHEET

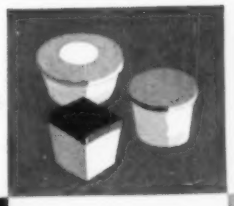
Many complicated refrigerator and appliance parts like freezer doors and crisper boxes are made with easily formed Styron® 475 sheet!



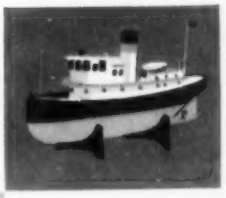
There's no limit to colorful, high-impact Styron sheet's applications in the novelty fields!

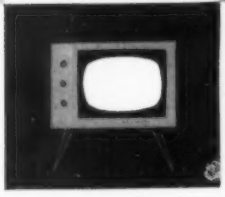
Many beautiful three-dimensional displays and signs are formed of low-cost Styron 475 sheet!

The list of its advantages below shows why more and more packaging men have turned to dependable Styron 475 sheet!



Versatile Styron 475 sheet sets the pace for realistic detail, extra play value and longer play life in today's fastest-selling toys!





Styron 475 sheet is the choice of many radio and TV manufacturers for masks, back and tube enclosures and insulating shields!

YOUR PRODUCT GOES HERE

You can use these Styron 475 sheet advantages to cut your operating costs—

1. Economical
2. Will not corrode, rust or tarnish
3. Easily formed and fabricated (punched, die-cut, stamped, vacuum-formed)
4. Adaptable to most painting and printing methods
5. Excellent resistance to water and moistures
6. Will not support mildew, mold and fungi
7. Lightweight
8. Chemically compatible with a majority of packaging materials
9. Reusable or disposable
10. Wide range of opaque and semitranslucent colors
11. Nontoxic
12. Has good chemical resistance

Yes, imaginative engineering minds have made plastics a basic part of almost every industry you can name. Styron 475 sheet is a high impact polystyrene plastic formulation produced as a sheet in a variety of sizes, thicknesses and colors. Developed by Dow through advanced extrusion techniques, it is a vital factor in the swing to plastics as a profitable production material. Styron 475 sheet is available from leading manufacturers throughout the country. There are also leading fabricators nearby ready to form to your specifications. Return the coupon above today, and put Dow's experience and leadership in plastic sheet to work for *you*. Our pledge: *Prompt*, personal attention to your needs.

you can depend on DOW PLASTICS

DOW

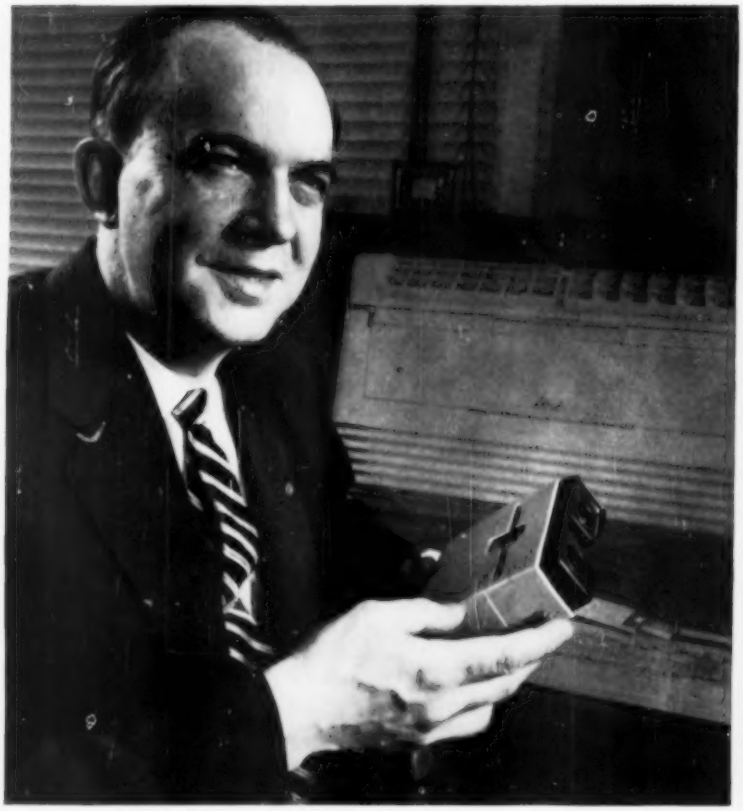
Craftsmen of the 20th Century

No. 7 of a series to introduce you to some of industry's outstanding plastics craftsmen

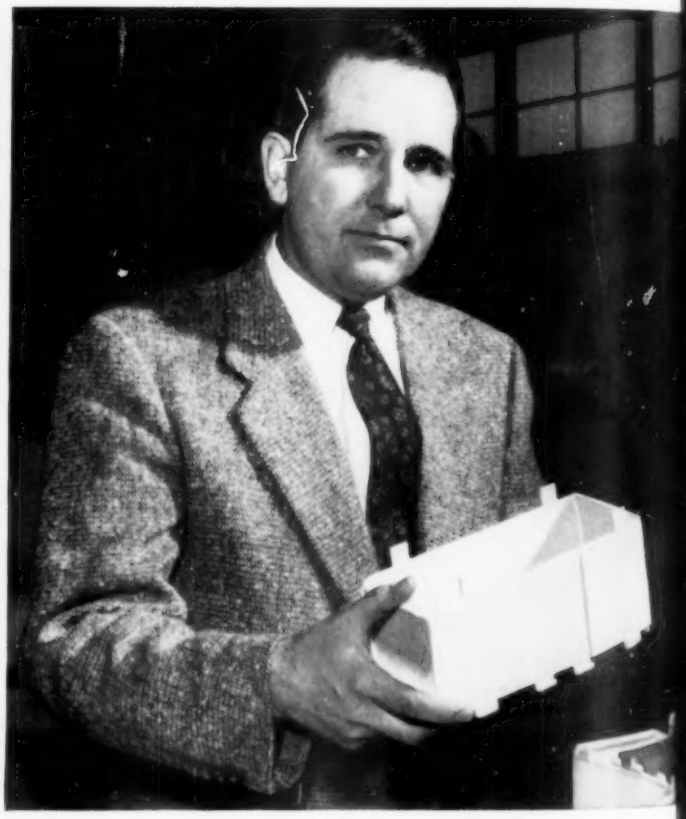
This advertisement is reprinted from the September issue of Dun's REVIEW AND MODERN INDUSTRY, where it was seen by more than 118,000 business leaders

Challenged by the materials at hand, the artisans of other ages enriched the world with beautiful objects of wood and silver, iron and glass. Today's craftsmen are applying the same creative skills and the same zeal on perfection to the mastery of new materials—the fabulous family of plastics. Pictured here are two of these modern specialists who are molding plastic products to serve every industry, every home. Monsanto, a major producer of high-quality plastic materials, salutes these craftsmen who are helping to mold America's tomorrow.

When your plans call for plastic parts or products, consult an expert custom molder



John Faloon, General Electric Company, Taunton, Mass. With General Electric in a technical capacity since 1937, Mr. Faloon guides the work of over 350 molding presses and 40 technicians at the Taunton Plastics Department. More than 6,000 different molds have been designed and built here for the production of mass market items, like the viewer shown, as well as for industrial and military applications. A mold to produce plastic proximity fuses for trench mortar shells, with which 30 million intricate parts were molded to exacting government specifications, is among the jobs Mr. Faloon helped engineer.



Arthur Peterson, Cambridge Panelyte Molded Plastics Co., Richmond, Indiana. Twenty years ago Mr. Peterson started up one of the first three hydraulic-operated injection molding presses in America. Today, as Chief Inspector and Tool Engineer, he is responsible for all mold maintenance, tool design alterations and ultimate operation. Under his supervision, specifications permitting only .002-inch tolerance have been met. He once ran a refrigerator door shelf job around the clock 7 days a week for 3 months with only 4 hours down-time. In-plant scrap was less than .5% and not a single part was returned.

MONSANTO CHEMICAL COMPANY,
PLASTICS DIVISION, SPRINGFIELD 2, MASS.

MONSANTO

LUSTREX
Styrene Plastic

Plastics Engineers—*When?*

Lloyd A. Chacey
Executive Secretary of the
Ohio Society of Professional Engineers

A question which immediately arises in some minds, of course, is, "How can I get registered as a plastics engineer?" The answer probably is that you cannot get registered as a plastics engineer. This situation is not a temporary condition for under the law in most states they probably can give you registration as a Professional Engineer only.

Most, if not all, states allow a person to qualify for registration by qualifying in his chosen branch if that branch is recognized in that state. In Ohio where examinations are required, even of the college graduates, the examinations are given in all branches in which degrees are awarded by an approved engineering college in the state of Ohio. The only registration given in Ohio, however, is that of "Professional Engineer."

Every state has a specific registration law of its own so each person interested in registration must investigate the law in his own state. Each state also decides which if any branches will be recognized for registration or for examination. The trend in the U.S.A. is toward registration as professional engineer, but the practice of examining applicants in their field or branch still holds.

The beginning of the recognition of a branch of engineering then comes through the college door. Plastics engineering will probably come into recognition the same way other branches have. As important a branch as aeronautical engineering is only a few years old.

Registration, however, is available regardless of the type of engineering. It is available to those who can qualify under the laws of their state. In Ohio, for instance, the law requires four years of education and/or experience satisfactory to the Board of Registration before a person can take the examination. After passing the examination a person is certified as an engineer-in-training. At the completion of four more years of experience the engineer-in-training enrollee submits a report to the Board for the purpose of showing the required knowledge and experience for full registration. If a person wishes to qualify legally so that he could call himself a Plastics Engineer in Ohio he would have to qualify legally as a professional engineer and then lay claim to the terminology of plastics engineer through experience or education. In other words, he must become a professional engineer first.

To do this he would take the same examination the first day as any one else. On the second day of the exam he would have to choose one of the 14 branches in which examinations are conducted by the Board. The branch of plastics will not be given in Ohio until a degree in plastics is conferred by one of the recognized engineering colleges of Ohio.

Recognition of Plastics as a branch of engineering then may be a slow process. Recognition of individuals as registered or professional engineers is available now to persons even without a college education if they can qualify under their state laws.

What do others think of you calling yourselves plastics engineers? That will vary. It depends entirely upon the experiences, the convictions and the ambitions for the profession of the individual expressing the opinion. When the day comes that almost all college graduates are registered as professional engineers then the public will expect everyone who calls himself an engineer of any kind to be able to prove it and qualify according to the laws of his state.

The time will come, and possibly sooner than you think, when those who call themselves Plastics Engineers will also have to be registered engineers in order to keep from being misunderstood. In fact most anyone who reads in the Revised Code of Ohio, for instance, that "No person shall practice or offer to practice the profession of engineering or of surveying, or use in connection with his name or otherwise, assume, use, or advertise any title or description tending to convey the impression that he is an engineer or a surveyor, unless such person has been registered or is exempted under sections 4733.01 to 4733.23, inclusive, of the Revised Code," will question the right of a man who is not registered, to call himself a plastics engineer.

Let's look further, however, into the legal exemptions. Listed under section 4733.10 we find an exemption "for the performance of engineering or surveying which relates solely to the design or fabrication of manufactured products."

The question then arises. Why should Plastics Engineers seek registration in Ohio? They are producing manufactured products in most cases and are exempt. Many examples such as recognition in court cases and the right to collect fees for consulting services, could be mentioned. However, if those persons who expected to need their registration for the above mentioned reasons were the only ones in industry who sought registration, then there would not be the thousands of registered engineers we find in industry today all over the U.S.A.

The reasons why engineers in industry have sought registration, of course, are many. In my opinion most of them have looked with favor upon this movement because, registration has carried with it the stamp of professionalism. Also, registration is thought of as the gateway to recognition by an ever increasing number of people who think that in order not to mislead the public when one calls himself an engineer, he must be a registered engineer.

There are some industries that require registration and others that recognize it as a professional achievement worthy of considerable note. These small beginnings will grow.

Registration began as a lone tree that had its beginning in the State of Wyoming back in 1907. By 1950 every state including the territories and the District of Columbia, had registration and the engineering woods was full of these trees.

(Please turn to page 36)

use the Right Material

J. Harry DuBois
Vice Pres. Engineering
Mycalex Corporation of America
Clifton, New Jersey

PLASTICS ARE USED advantageously by the product designer when they contribute essential or desirable properties more economically than other basic materials. The special properties of the plastics have greater value when they are efficiently used in the overall product design. Interesting and valuable results that may be derived by the correct use of the proper plastic include the following:

1. Electrical application materials are available for each type of problem such as for high voltages, high frequencies, high current arcs, semi-conductors, permeability cores, anti-statistic, capacitors, high and low temperatures, and for corona insulation stability.
2. Many of the plastics offer very unusual chemical resistance properties so that products may be designed to meet almost any corrosion problem by the proper material selection. For example, polyethylene is not attacked by hydrofluoric acid which destroys glass and metal.
3. Plastics have attractive tactile characteristics resulting from their low thermal conductivity and their very smooth and attractive surfaces. Handles attached to very hot or very cold sources take advantage of this and make the user unafraid to touch those parts made of plastics.
4. Most plastics are available in a wide selection of colors and textures. The product stylist can gain appearance advantages by suitable styling since desirable contours and shapes, that must be avoided when other materials and processes are used, may be produced economically by some of the many plastics processing methods.
5. Certain plastics materials, when used as an integral structural section of the product, may take advantage of the thermal insulating properties, simplify the product design, and minimize assembly costs. Other plastics have higher thermal conductivity and assist in the transfer of heat.
6. Noise may be reduced and vibration minimized by the use of plastics. Some of these materials are mechanically non-resonant and will dampen vibrations in any assembly. Many of the plastics have elastic properties that will absorb undesirable vibration and sound.
7. Most of the plastics have greater strength per unit of weight than the metals and the weight of most products may be reduced by the use of proper plastic material. Weight is a large factor in the selection of certain plastics which are subject to rotation and inertia forces. Plastic products in the "as-molded" state are more perfectly balanced because of their lower weight and greater uniformity of density.
8. For cams, gears, bearings and other rubbing surfaces, certain plastics exhibit wear resisting characteristics that indicate their use at any price.

Numerous limitations are imposed on the various plastics materials because it is not always possible to get the full desirable balance of properties in a single material. Each material type is significant because it exhibits certain desirable special properties—at a price. No one material possesses the entire range of properties and compromises are essential. For example, it may be desirable to attach a lifting knob to a heated platen. The general purpose phenolics have fairly low thermal conductivity but must not be used above 250° F. A high temperature type of phenolic compound that would take the temperature has greater thermal conductivity and gets too hot to touch. Thus, in every case the designer must evaluate the limitations of each material to make sure that the balance of properties will be satisfactory. In each application, certain desirable properties of the plastics material are coupled with some weakness that may prevent its use in a given product or necessitate a basic design change.

Another important limitation is the production cost factor. The tooling cost must be considered carefully prior to designing custom molded plastics into small-volume items. Simple shapes may be fabricated by conventional machining processes; more difficult shapes must be molded. Wood, concrete and special composition molds may permit low pressure molding of small-volume products. The cast plastics may be used for certain products with low tool investment. Blow molding may be satisfactory and low cost method of producing re-entrant shapes.

The electrical component pictured at the top of the page requires high values of resistance to arc, thermal shock, voltage and high corona stability as well as mechanical strength. Five different insulating materials are used in this assembly, each to perform its own special function.

Most of the failures connected with plastics product design have resulted from incomplete knowledge of the operating conditions or lack of consideration for the limitations of the materials selected. All known operating conditions and requirements must be passed along to the plastics engineer who is responsible for the materials selection. In critical applications a handmade or sample molded part should be tested to destruction. Numerous failures have resulted from inadequate impact strength, arc resistance, chemical properties, moisture, dimensional, thermal and age stability, or excessively close tolerance requirements.

Many designs have failed because the designer was unwilling to recognize that certain of the plastics are not dimensionally precision materials like the metals and that their higher co-efficients of expansion introduce numerous dimensional and differential expansion problems that must be given careful consideration. Large-volume products require greater dimensional latitude than small-volume products because of the thermal and dimensional variables in the multiple cavity molds used for large-volume production.

Products that are to be made in very small volume or those that may be designed for the simple processes such as stamping, punching, turning, or sawing should be made from the laminated plastics, glass-bonded mica, or from vulcanized fiber. Selection of the proper fabricating material is relatively simple because the properties are well defined and the choice is limited.

Selection of the proper molded material necessitates the study of numerous considerations to make sure that the economical material with a suitable balance of properties is selected. The starting point in the selection of the material is an analysis of the good points and the weak points of each material that may be suitable for the job. No one material will have all the plus qualities with no minus considerations. The negative qualities must be compensated for in the product design.

Selection Guides

A workable sequence of material consideration might be as follows:

If an elastic plastic is required, the choice is limited to polyethylene, vinyl, polytetrafluoroethylene, or a synthetic rubber compound. Nylon may be suitable in cases where the elastic rebound requirement is small. Polyethylene and vinylite are both limited to low temperature (175° F.) applications and if the temperature requirement goes above this limit, the synthetic rubber and silicone rubber compounds must be considered.

Temperature requirements (See Table I) indicate another broad division since high temperature applications (over 450° F.) require the use of the cold molded compounds or glass-bonded mica.

Medium temperature jobs (250° F. to 400° F.) may be served well by the glass or mineral filled phenolic, silicone, melamine, alkyd, or polytrifluorochloroethylene plastics.

The plastics materials vary widely in impact strength and this is a fundamental material selection consideration that may eliminate certain high modulus materials.

Products requiring best arc resistance are limited to the alkyd, cold molded, melamine, or glass-bonded mica materials. High current, high thermal shock applications need glass-bonded mica. Radiation resistant applications require glass-bonded mica or ceramic components; the organic plastics deteriorate very rapidly under radiation.

Temperature Limits For Various Materials

SYNTHAMICA melts	2550
Electrical porcelain—firing temperature	2400
Glaze for porcelain—firing temperature	2250
SYNTHAMICA — maximum heat resistance	2200
Raw lead pottery glazes—firing temperatures	2000-2060
Copper melts	1981
Furnace temperatures in glass manufacture	1900-2800
SYNTHAMICA — sustained service	1800
Natural phlogopite mica—maximum heat resistance	1800
Silver melts	1762
Aluminum melts	1220
Silver solders melt	1165-1450
SUPRAMICA 500 — maximum heat resistance	1000
Cold-molded refractory and phosphoasbestos—maximum heat resistance	900-1300
Calcium aluminum silicate—maximum heat resistance	900
Aluminum alloy melting points	850-1225
Muscovite mica—maximum heat resistance	800-1000
SUPRAMICA 555 — maximum heat resistance	950
Zinc melts	786
MYCALEX 400 — sustained service	700
Magnesium alloy melting points	650-1200
MYCALEX 410 — sustained service	650
MYCALEX 410X — sustained service	650
Lead melts	621
Cadmium melts	610
Silicone-glass heat distortion	575
Cold-molded plastic (organic)—sustained service	500
Polytetrafluorethylene—sustained service, no load	500
Silicone-glass sustained service	480
Tin melts	450
Silicone rubber—sustained service	425
Cold-molded plastic (organic) heat distortion	400
Polyester-glass heat distortion	400
Cellulose-filled melamine heat distortion	400
Polymonochlorotrifluoroethylene—sustained service, no load	390
Mercury boils	357
"Hottest spot"—Class H insulation	356
Polyester, mineral-filled, putty—heat distortion	375-425
Alkyd: polyester, mineral-filled, granular—heat distortion	350-400
Epoxy-glass cloth—maximum temperature	315
Silicone elastomer—sustained service	300-500
Nylon (polyamide) heat distortion (66psi)	300-360
Casein heat distortion	300
Urea-formaldehyde heat distortion	275
Polytetrafluoroethylene heat distortion (66psi)	270
"Hottest spot"—Class B insulation	266
Melamine-formaldehyde (filled) heat distortion	266-400
Diallylphthalate (alpha cellulose filler) heat distortion	265-310
Phenol-formaldehyde (mica) heat distortion	260-350
Phenol-formaldehyde (wood flour) heat distortion	260-340
Hard rubber (mineral-filled) heat distortion	260
Sulfur (rhombic) melts	235
"Hottest spot"—Class A insulation	221
Paper Phenolic laminate—sustained service	212-250
Styrene elastomer—upper limit	212
Epoxy—maximum recommended use	212
Water boils	212
Polyvinyl carbazole heat distortion	210-300
Vulcanized fiber—upper limit	200
"Hottest spot"—Class O insulation	194
Polydichlorostyrene heat distortion	185-230
Polymonochlorotrifluoroethylene heat distortion (66psi)	160
Polystyrene heat distortion	152-210
Methyl methacrylate heat distortion	150-210
Styrene copolymer heat distortion	148-235
Vinyl chloride heat distortion	140-185
Cellulose nitrate heat distortion	140-160
Hard rubber (no filler) heat distortion	140
Vinylidene chloride heat distortion	130-150
Cellulose acetate butyrate heat distortion	120-210
Cellulose acetate heat distortion	115-235
Ethyl cellulose heat distortion	115-190
Vinyl butyral heat distortion	115-140
Polyethylene heat distortion (66psi)	107
Temperature of human body	98
Normal room temperature	72
Water freezes	32
Lower limit for ethyl cellulose	0
Lower limit for vinyl chloride elastomer	—38
Mercury freezes	—38
Silicone elastomer loses flexibility	—60
Lower limit for polyisobutylene	—80
Lower limit for polytetrafluoroethylene	—90
Lower limit for polychlorotrifluoroethylene	—100
Dry ice (CO_2) sublimes	—109
MYCALEX glass-bonded mica undamaged	—110

From this point the material search may be limited by color requirements. Urea, nylon and melamine compounds offer good colors in the 180°-250° F. temperature range. Nylon is not dimensionally stable under elevated temperatures and loads and must be tested for each application. The phenolics are suitable in this temperature range but their colors are not fast in the light shades. Dark red, brown, walnut, mahogany and black are the stable phenolic colors. The thermoplastic materials such as polyethylene, the acetates, styrenes, acrylics, and their copolymers offer a wide color selection in the temperature range below 175° F. Glass-bonded mica offers a very limited color range.

Bearings, cams, gears and rubbing surfaces may be made from the laminates, special phenolic molding compounds or from nylon. Bearing and similar applications must give adequate consideration to the high thermal expansion when clearances are calculated. Many plastics bearings are also water lubricated and require added study of the effects of swelling from the water.

When maximum transparency is desired, such as for lenses, the acrylic material is the best choice; polystyrene provides good clarity and better surface hardness.

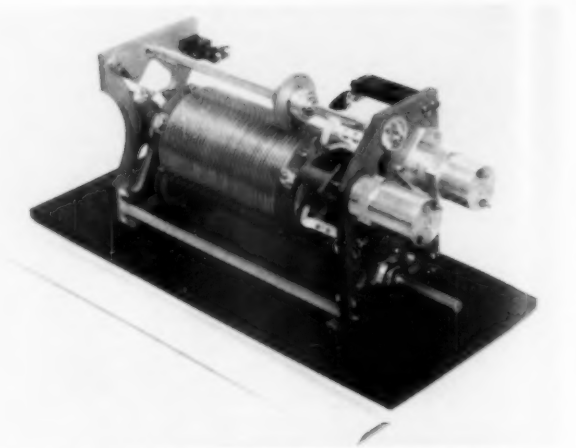
Rain erosion is an important consideration in selecting materials for missiles and aircraft. At very high speeds, the hardest materials give best results; the elastic materials withstand erosion best at low speeds.

Moisture, acid, solvent, caustic, and other chemical problems indicate another broad search classification that further limits the field to those few that will do the job under consideration. Plasticizer migration may be an angle at this point that must be evaluated. Many of the thermoplastics are loaded with plasticizer that will pass to adjacent lacquered surfaces or plastics and cause damage.

Permeability of gases and liquids is a most important factor in selecting a packaging material. Some plastics films will pass certain ingredients and hold others, changing the basic formulation of the product. Packaging materials should be selected only after adequate "shelf life" tests have been completed.

The electrical requirements are clean cut and some materials carry rather broad coverage in this field. The most difficult electrical problem is the high frequency-high temperature insulator and there are a few special purpose materials to help these applications. Glass-bonded mica is the best of the high temperature electrical materials. Electrical circuits which must maintain stability throughout humidity changes require polystyrene, polyethylene, glass-bonded mica, or the fluorocarbon products. Tetrafluoroethylene and styrene are best for products requiring minimum loss factor.

Dimensional stability is often an important factor and the field is limited when really tight dimensional stability is a requirement. The only materials that may be considered for maximum dimensional stability requirements are glass-bonded mica and the ceramics. The mineral filled phenolics—with an after-bake subsequent to molding, are second choice; the alkyd compounds are also to be considered. Of the thermoplastics, the styrene, ethylcellulose, and the vinyls may be satisfactory when the dimensional stability requirements are not too severe. Highly plasticized compounds such as the acetates must be avoided because age loss of the plasticizer may cause serious dimensional change. The dimensional stability of the various materials is affected by moisture and temperature; most of the organic plastics have high thermal expansion. The thermoplastic compounds change dimension rapidly under stress (cold flow) at temperatures near their softening point. Most plastic products must not be used for the critical parts of machines or instruments where the performance of the device is dependent on the dimensional stability of the molded piece, without making allowance for differential expansion and variation. Glass-bonded mica is the only material with total dimensional stability suitable for precision products. In business machines, large housings, etc., the design will be satisfactory if the inner mechanism is not supported by the plastics housing. All interior mechanism must be an integral assembly with the plastics enclosure serving only as a housing. Moisture absorption, age shrinkage, warpage or distortion may cause the mechanism to bind if it is tied firmly to a plastic material with poor dimensional stability and high thermal expansion.



Glass bonded mica is the only fully satisfactory answer to high voltage, high frequency, high temperature, low electrical loss applications such as this tank coil assembly.

Weather Resistance

Weather resistance is a large weakness in many of the plastics. Shellac, glass-bonded mica and alkyd resin are the best selection for outdoor service. Acrylics and polyethylene plastics are suitable for many outdoor jobs and some of the styrene copolymers may perform satisfactorily.

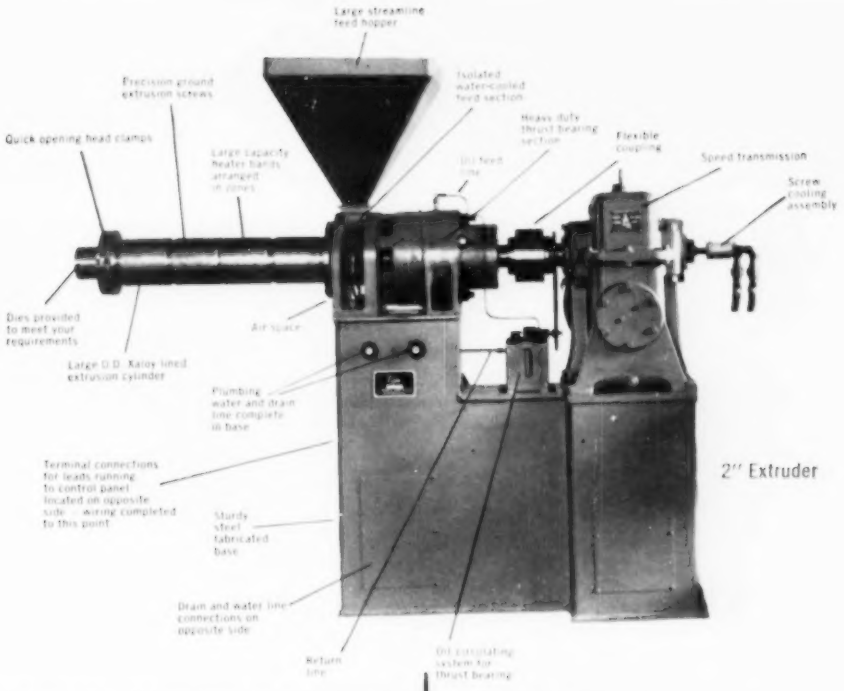
Odor and taste requirements will limit the choice since many of the plastics have a strong odor and may impart a taste to food. Melamine, urea, glass-bonded mica, polystyrene and polyethylene are particularly good in freedom from odor. There are some minimum odor phenolic molding compounds and laminates.

The alternative production processes such as the reinforced plastics, blowing, and vacuum forming of sheets, must be evaluated carefully since they offer many production advantages and will indicate their own materials.

When it comes to product engineering, the molder of today is prepared to tell you to throw all the limitations; there is a way to do every job the way you want it done if you are prepared to pay the price. These limitations are imposed by tool design considerations, material shrinkage and subsequent finishing operations. Low cost, continuous production programs follow well defined channels that are well known to most plastics engineers.

Cost is a final consideration in the material selection since the wrong material is always the most costly. The price per pound of the material is a poor cost barometer since density and the molding method may make a very expensive material the lowest cost material for your product.

Egan plastic extruder


Large streamline feed hopper
Precision ground extrusion screws
Isolated water-cooled feed section
Heavy duty thrust bearing section
Flexible coupling
Speed transmission
Screw cooling assembly
Quick opening head clamps
Large capacity heater bands arranged in zones
Dies provided to meet your requirements
Air space
Large O.D. Xaloy lined extrusion cylinder
Plumbing — water and drain line complete in base
Terminal connections for leads running to control panel located on opposite side — wiring completed to this point
Sturdy steel fabricated base
Drain and water line connections on opposite side
Return line
Oil circulating system for thrust bearing

2" Extruder

compare with the covers off!

Yes, when you remove the covers and get down to the bare facts of construction of this unique extruder, you will find a machine which will have longer effective screw lengths, greater maximum heating capacity, and larger thrust bearing capacity. This will add up to higher production rates, better products, and lower maintenance and operating costs. With the flexible design of the "extrusion" unit consisting of the separate components; screw, heating cylinder, feed section; and thrust bearing housing, we can give you any combination to meet your requirements.

EGAN EXTRUDERS are supplied complete with a *wired* control panel including the main disconnect switch, fuse blocks, contacts and temperature controls *mounted*. Plumbing for the water supply and return lines to the drain are completed in the base. Installation costs are held to a minimum.

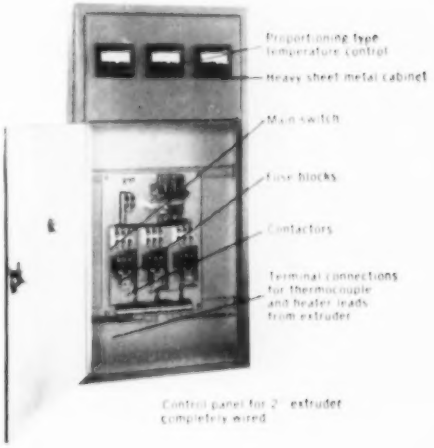
EGAN EXTRUDERS can be furnished with dies, conveyors, take-off equipment and other auxiliary features for a wide range of extruded products.

Write for details or invite our representative to call

FRANK W. EGAN & COMPANY, Somerville, New Jersey

Designers and Builders of Machinery for the Paper Converting and Plastics Industries

Cable Address: "EGANCO" Somerville (NJER)



Control panel for 2" extruder completely wired

Compare specifications of any standard Egan Extruder, size for size, with any other extruder.

Standard Sizes (Screw Dia.)—inches	2	2½	3½	4½	6	8
Effective Screw Length—inches	32	40	56	72	96	128
No. Cylinder Sections	1	1	1	1	2	2
Zones of Heating on Cylinder	2	2	3	4	4	4
Maximum Heating Load, KW	12	18	30	48	96	160
Thrust Bearing Capacity, 1000 lbs. @ 50 rpm.	60.5	60.5	119.5	208	288	420
Type Speed Transmission	Worm gear.	Worm gear.	Herr' bone	Herr' bone	Herr' bone	Herr' bone
Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
Approx. Extrusion Capacity lb./hr.	20-50	40-90	75-200	150-450	250-650	450-1200
Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
Approx. Weight—lbs. (less Drive)	3200	3600	4800	6600	9600	12500

**Extruders are modified to meet requirements for a particular process*

AROUND THE WORLD

★

UNITED STATES

ELECTRICAL MANUFACTURING

Vol. 55, No. 3, March, 1955

Abstracter: Gerald Eisner

GLASS PREMIX COMPOUNDS FOR MOLDED PARTS—Roger White

The author, President of the Glastic Corp., presents an introduction to a rapidly expanding use of plastics in the electrical field.

Glass premix molding compounds are made with short glass fibers, resins (usually polyesters) and inert fillers. This article describes the properties of moldings made with different proportions of ingredients and gives examples of some highly successful applications. Such properties as high impact strength, light weight, flexibility of design and low cost serve to great advantage.

Mr. White concludes with short discussions of ten processiing and application problems and his suggested solutions.

Vol. 55, No. 4, April, 1955

THE EPOXY-RESIN SYSTEM FOR EMBEDDED CIRCUITS AND COMPONENTS — Alex E. Javitz

With outstanding adhesion to metals and with low shrinkage during cure, the epoxies can be compounded and reacted to provide a flexible and wide range system of casting resins for embedment and encapulation applications. By manipulation of catalysts, hardeners, fillers, plasticizers and diluents, the properties of the plastic can be varied to meet a wide range of electrical, mechanical, thermal, chemical and cost requirements.

In this article the author, a staff writer for Electrical Manufacturing, discusses many of the development problems, gives case histories and also lists resin suppliers, compounders, and formulators.

Vol. 55, No. 5, May, 1955

SILICONE RUBBER-SEALED LOW-TEMPERATURE SWITCHES — P. C. Servais

Mr. Servais of Dow Corning gives examples of the use of Silicone Rubber in electrical switches for protection from intermittent exposure to extreme moisture and temperature conditions. Excellent photographs and drawings show methods of attachment in components which have been thoroughly tested.

Vol. 55, No. 6, June, 1955

IMPACT OF HIGH ENERGY RADIATION ON DIELECTRICS—Alex E. Javitz

Practically all of the important properties of the organic polymers are subject to change under irradiation. In this article the author first describes various types of radiation and then discusses their mechanical and electrical effects on plastics now in use as dielectrics. Excellent photographs which accompany this technical paper vividly show some of the most dramatic effects, eg. embrittlement and gaseous decomposition.

One important consideration that was emphasized was that radiation shielding designed to protect human beings would certainly protect plastic electrical components.

★

THE GLASS INDUSTRY

July, 1955

Abstracter: Gerald Eisner

SENSITIZING — A PROCESS USED IN SILVERING — Samuel Wein

There are three reasons why a sensitizing process is necessary before silvering any surface: It increases adhesion of the silver; it reduces the time of formation of the film; and it promotes a more uniform film. The author discusses the history of sensitizing along with the chemistry theory behind the use of tin chlorides.

The major portion of this article deals with the method of preparation and application of the various compounds to the surfaces to be silvered. Special consideration is given to the coating of plastics such as phenolics, vinyls and others.

An excellent reference listing of authorities in the field is included at the end of the article.

★

ARGENTINA

PLASTICS INFORMATION SUPPLEMENT TO PLASTICOS

April, 1955

Abstracter: John B. Ballard

PHENOL WILL BE MANUFACTURED IN OUR COUNTRY — EDITORIAL

Government approval has been given for the investment of $375,000 (dollars) in a new company, Fabrica Argentina de Fenol Y Derivados. The company will be owned 65% by a group of local investors represented by Compania Quimica S. A. and 35% by Farbenfabriken Bayer A. G. of Leverkusen, Germany, and Bunge Y Born Ltda. S. A. A synthetic phenol plant having an annual capacity of 1800 tons is to be built in San Nicolas and is to be in operation within thirty months.

★

AUSTRALIA

AUSTRALIAN PLASTICS

Vol. 11, No. 115, Feb., 1955

Abstracter: Albert Lightbody

GLASS FIBER MATERIALS, PART 1, POLYESTER RESINS — F. L. Connors. pp 7-17

The first of four articles on this subject. The chemistry of ployesters is very simply explained. The variations that are possible with varying compositions and the effect of inhibitors, catalysts and accelerators are effectively shown by graphs of exotherm curves, curves of geltime vs concentration of catalysts and accelerators, and viscosity-monomer concentration curves.

NEW MATERIAL NOW AVAILABLE TO PLASTICS INDUSTRY p. 21

Announcement is made that high impact polystyrene is now being produced in Australia by Walter Barr Pty., Ltd., a division of International Products, Ltd.

FLOW DATA FOR SMOOTH BORE PLASTIC TUBES — p 31

A full page chart from which the pressure drop in smooth bore plastics tubes for Reynolds numbers up to 100,000 is given.

AUSTRALIAN PLASTICS

Vol. 10, No. 19, June, 1955

VACUUM FORMING AND THE FUTURE OF LARGE INJECTION MOULDINGS — Alan B. Glanvill. pp 13-15

The requirement for large plastics pieces calls for a comparison of the ways they can be made and an evaluation of these processes. Large injection moldings can produce rigid, polished moldings, completely finished with a wide scope in design and a maximum economy in material. The high cost of machines and tools makes extensive runs mandatory for economy. Vacuum forming has the advantage of low cost machines and tools with fast operation. Thin walled moldings are possible with preprinted or multicolored sheets. It suffers the disadvantages of more expensive material with wastage in cutting sheets to size. Holes and inserts must be cut. Trimming is usually essential and thinning on deep draws is a constant danger.

TEST FOR PLASTIC PIPING—p-17

A large scale water-relaying exercise in London was carried out by more than 400 men and women of the Auxiliary Fire Service. Sixteen ft. lengths of 6 in. polyethylene pipe, weighing 50 pounds each, was used. (Abs. Note: The U. S. Civil Defense should take note of this.)

NITRILE RUBBERS AS PLASTICIZERS FOR POLYVINYL RESINS — S. E. Bolam. pp 18-22

The advantages and disadvantages of nitrile rubber as a plasticizer for polyvinyl resins are compared with those of ester type plasticizers. The processing changes and the limitations in flexibility are listed as the chief disadvantages. Consequently, nitrile rubber is usually not the sole plasticizer used. Greater resistance to oils, solvents, heat aging and low temperature brittleness are achieved at the expense of lower strength and extensibility.

SURVEY OF MANUFACTURING ACTIVITY IN AUSTRALIA, APRIL 1954 — pp 45-46

Phenol formaldehyde resin production increased about 30% in the year commensurate with sales. Polystyrene production which has only recently been made in Australia, has been low due to the lower cost of imports. Polyvinyl chloride manufacture is expected to increase with a new large plant in six months. Exports of plastics materials are mainly to New Zealand.

★

BRAZIL

REVISTA BRAZILIERA DE PLASTICOS

Vol. 2, No. 17, May, 1954

Abstracter: John B. Ballard

QUALITY CONTROL OF PLASTICIZERS — Otto Pesta. Page 9-11.

The physical and chemical tests of plasticizers of "Mollan" type produced by the Oesterreichische Stickstoffwerke A. G. in Austria are discussed.

PLASTICS, THEIR TECHNIQUES AND PROBLEMS — Eric Jeanrenaud Page 12-15.

The transfer molding is explained and discussed.

THE BABASSU AS A RAW MATERIAL FOR PLASTICS Page 20-21.

Reference is given to the experiments of Aluisio Alves de Araujo and Eloisa Biasotto Mano from the Instituto Nacional de Tecnologia, with Babassu nut shells as a possible molding material due to their high content of lignin and furfural. The shells (endocarp) are waste from the production of the Babassu oil and constitute about 57% of the weight of the fruit, 9% being the almond and the rest the epicarp and mesocarp. The analysis of the shells gave 32.01% lignin, 50.02% cellulose and 16.20% furfural. Molding experiments with this material in powder in 3 different degrees of furfural content performed in Carver press at 130-170°C and 5 min. molding time are said to produce moldings of very good appearance and resistance against water. The Babassu nut grows in the Amazonas, especially in the states Maranhao and Piaui. The present annual production of Babassu almonds is about 50,000 tons which leaves about 450,000 tons of shells. Plans are made by the Brazilian Economic Council to utilize this waste material and still increase the production.

Vol. 2, No. 18, June, 1954

A WORD TO MOLDERS — Eric Jeanrenaud. Page 4-8

The author evaluates the Brazilian plastics industry as a whole and compares it with conditions in Europe. He finds in Brazil more automatic injection molding machines than in Europe, this being due to the fact that plactics in Brazil are a much newer industry than in Europe, having as a rule practically no old equipment. He sees the following drawbacks in Brazil: insufficient production of starting raw materials, lack of qualified personnel, lack of cooperation, lack of initiative, lack of tool making industry and unsound competition among plastics producers. Among measures he recommends to improve the situation is the creation of a center of studies of plastics to solve various technical problems. All commercial plastics materials are discussed with the view of their actual or potential application in Brazil.

QUALITY CONTROL OF PLASTICIZERS — Otto Pesta. Page 10-11

A continuation of the discussion of chemical and physical tests of "Mollan" type plasticizers of the Oesterreichische Stickstoffwerke A. G.

PLASTICS, THEIR TECHNIQUES AND PROBLEMS—Eric Jeanrenaud. Page 19-20

Basic facts of extrusion molding are given and discussed.

GERMAN CONGRESS OF PLASTICS INDUSTRY—Page 7

Titles of papers presented at the German meeting at Stuttgart in October 1954 are given.

PLASTICS, THEIR TECHNIQUES AND PROBLEMS—Eric Jeanrenaud. Page 13-14

A continuation of the discussion of the extrusion molding problems.

A STIMULUS TO SELF-SUFFICIENCY—Page 27-29

A development and brief description of a synthetic resin plant in Sao Paulo is given (R. Montesano & Cia.), producing alkyds, modified phenolics and other varnish resins, which usually have to be imported.

★

DENMARK

PLASTIC

Vol. 5, No. 1, Jan., 1955

Abstracter: Erik R. Nielsen

TERMINOLOGY IN THE FIELD OF PLASTICS

Tentative standards of terminology are presented by the Danish Engineering Society. For each term, the equivalent term is given in Norwegian, Swedish, English, German, and French.

CALANDERING, EXTRUSION, AND INJECTION MOLDING OF UNPLASTICIZED PVC. Continued from Plastics Vol. 4, No. 12.

The second half of this paper presents a detailed discussion of the extrusion and injection molding of unplasticized polyvinyl chloride.

Vol. 5, No. 2, February, 1955

PLEXIDUR T. — Franz Esser.

Plexidur T (yellow color) is offered by Rohm & Haas, Darmstadt, Germany, as a complement to Plexiglas. Plexidur T has higher impact strength and better solvent resistance.

★

FRANCE

INDUSTRIE DES PLASTIQUES MODERNES

Vol. 7, No. 4, April, 1955

Abstracter: Hans Mayer

PLASTICS & DECORATION — Jean-Michel Barrault

Referring to decorative schemes employed in the construction of several public buildings and the use of plastic materials made therein in the form of wall coverings, structural members, lighting arrangements, furniture, etc. the writer points out that plastic materials are not any longer to be treated as substitutes for other raw materials, but have found uses exclusive to their particular qualities.

A NEW APPLICATION FOR POLYVINYL ALCOHOL—Charles Saint-Mieux

The author describes the characteristics, methods of fabrication, and suitable applications of a variety of polyvinyl alcohol which he has originated and tries to get patented. This variety results in a product which is capable to absorb sweat and can therefore be used advantageously for comfort and protection.

RIM FOR FLOOR COVERINGS

It is difficult to depose plastic or other floor coverings without leaving small openings where the floor touches the walls. A plastic edge has been developed which will fill this space and add a decorative touch by forming a beaded edge alongside of the wall.

COMPARATIVE EFFECT OF VARIOUS TYPES OF ELIMINATION OF STATIC ELECTRICITY —Robin Beach

Reason and types of static electricity are discussed and detailed instructions are given as to the suitability of various mediums for its elimination.

Vol. 7, No. 5, May, 1955

GAS PUMPS AND GASOLINE STATION SIGNS

Gasoline pump housings are molded from glass reinforced polyester materials, the headpiece of the pump housing with its advertising message is vacuumformed from acrylic sheet material to permit best possible illumination and visibility by day and nights. In order to keep the housing interchangeable with metal parts, used previously, no change in the design was made. The resin used is of the fire retarding type and the molded part cannot be corroded or otherwise attacked by constant contact with petroleum products. The advantages obtained are weight savings of 50%, elimination of regular repainting and other surface maintenance jobs, better resistance to abuses.

THE PRODUCTION OF POLYETHYLENE COATED PAPERS IN A PAPER MANUFACTURING PLANT

The installation and production methods used in the manufacture of polyethylene coated papers by the Etablissements Leon Riquet are described.

THE FEDERAL ICE SKATING RINK IN BOULOGNE-BILLACOURT — Louis Saint-Calbre

The author discusses how the employment of glass reinforced translucent sheeting as structural member of the building as well as source of light will make it possible to erect this structure within the limited budget of the Federation.

NEW APPLICATION FOR SILICONES — R. Serey

Amongst new applications protective coatings and coatings on sheets before electronic assemblies appear promising, also the application of silicone to appear to make it impervious to water seems to be new.

★

GERMANY

DER PLASTVERARBEITER

Vol. 6, No. 2, Feb., 1955

Abstracter: E. C. Bernhardt

THE PROPERTIES AND APPLICATIONS OF OPPANOL BA IN THE CONSTRUCTION INDUSTRY — H. Lange

A very complete survey of Oppanol (polyisobutylene) covering the topics: Plastics in the Construction Industry; Physical and Chemical Requirements for Moisture Barriers in the Construction Industry; Properties of Oppanol BA Sheeting; Processing Techniques for Oppanol BA Sheeting.

Vol. 6, No. 3, March, 1955

NEW DEVELOPMENTS IN FLAME SPRAYING AND FLOTATION SINTERING — E. Gemmer

A survey of equipment and materials used for flame spraying and flotation sintering in Germany. Several photographs of the operations. Flotation sintering is the process by which metal parts are covered with thermoplastics by preheating the metal part above the M.P. of the polymer. The metal object is then immersed in a fluidized bed of polymer. (small particles of polymer suspended in moving air stream).

★

KUNSTSTOFFE

July, 1955

Abstracter: Anne Schwend

HOT GAS WELDING OF RIGID AND SOFT PVC—H. Peukert

Better strength of welded seams, greater heat resistance and equal resistance against chemicals as base material is offered by hot gas welding of rigid PVC with welding rods free from plasticizers in contrast to those holding plasticizer. Welding pressure, output remain the same at higher welding temperatures. Working range for soft PVC is broader than for rigid PVC, but insufficient binding or inclusion of decomposed material occurs when temperature rises beyond working range.

WELDING OF SOFT PVC FILMS —Karl Oberbach

The three commonly adopted welding methods: heat impulse, hot wedge and HF are described and applicability investigated.

WELDING AND MOLDING OF SARAN FABRIC—Lothzar Kreft

Discussion of Saran fabric properties from Saran Webereien at Cologne (85% vinyliden chloride, 15% vinyl chloride) is followed by description and evaluation of different working methods: welding with nickel-plated hot wedges, HF welding, blow and suction molding as well as deep drawing. Welded seams never exceeded 25% of normal strength of fabric, factor which cannot be increased due to loss of part of orientation and corresponding strength of individual threads during welding.

BEHAVIOUR OF RIGID THERMOPLASTICS DURING NON-CUTTING SHAPING—August Kleine-Albers

Investigations of the behaviour of rigid PVC during shaping at temperatures below the second order transition point and in its thermo-elastic status between second order transition point and flow temperature, effects of uni-dimensional stretching and a number of non-cutting shaping methods.

PLASTICS AND PLASTICS PROCESSING AT THE GERMAN INDUSTRIES FAIR AT HANOVER— Josef Hausen

A. Chemical

Farwerke Hoechst: "Hostalen" low-pressure polyethylene: specific weight .94, melting zone 128 to 135° C., tear strength until rupture 190 to 210 kg/sq.cm., elongation at break 700 to 800%, applicable at temperatures between minus 30 and plus 80° C. "Hostaphan" film — polyethylene glycol therephthalate. "Hostalit" PVC with a K-value of 70, now in production.

Farbenfabriken Bayer: "Durethan BK Plastisch" polyamide with a plastic zone of up to 15 to 20° instead of the normal 3 to 5° C., permitting use of cheaper injection molds than hitherto possible. "Durethan BK Pulver"—polyamide powder for sintering. Powder particle size below 70 u,.

Rudolph Koepp & Co.: "Pantarin" foamed plastics among which a synthetic sponge of identical appearance and structure as natural sponges.

Anorgana GmbH: "Gentotherm" PVC film, up to .5 mm in thickness for deep drawing of large size containers. PVC floor covering on felt base.

Roehm & Haas: Lacquers on the basis of Plexigum for screen printing of Plexiglass permitting far-reaching deformation also after printing.

Wacker-Chemie: New cold vulcanizing silicone caoutchoucs.

Imhausen-Werke: "Product of Development No. 758" anti-static plasticizer for PVC floor coverings.

Glasurit-Werke: "Glassit" liquid plastic for refining of wooden surfaces to render them resistant against impact, scratches, oil, weather and light, ink, etc.

Bolta-Werk: Highly impact resistant plate material "Boltaron" for vacuum forming, "Saran Filaments" for cover materials.

B. Presses and Injection Molding Machines

Tueckmantel Hydraulik-Bau: A novel oil pressure pump with automatically lifting suction valve for pressureless circulation of pressure-oil after reaching preset peak pressure to prevent heating of oil, making high-speed plastic presses suited for continued operation.

Eckert & Ziegler: Hydraulic injection molding machine type EH 380, molding capacity up to 200 grams, provided with special safety device.

Netstal AG: New high-speed automatic injection molding machine, piece weights up to 80 grams, plasticizing capacity increased thru "laminated plasticizer unit." Presetting of injection ram's stroke permits full or part use of capacity.

Gebr. Battenfeld: New ½ oz. high-speed fully automatic injection molding machine with up to 15 shots per minute.

C. Extruders

Maschinenfabrik Paul Troester: New extruder, screw dia. 200 mm, plasticizing capacity 500 kg of soft PVC per hour, with new Schaerer-Beier drive for infinitely variable control of screw rotations.

Frieseke & Hoepfner: Annular fissure at screw's end of extruder controls plastic flow in screw channels, renders superfluous insertion of strainers, torpedos.

CLEAR AND TRANSPARENT FILM FOR HORTICULTURE — W. Behrens

Acella-Werke at Hanover introduced new PVC film for horticultural purposes, having mirror-like finish outside and mat inside for perfect light diffusion and elimination of shadows. Interesting results of two years' experience speak in favour of future use of plastic films for greenhouse cultivation.

★

GREAT BRITAIN

BRITISH PLASTICS

Vol. 28, No. 4, April, 1955

Abstracter: E. A. J. Mol

VINYL FILM IN TAPE MANUFACTURE—pp 122-125

More than 200 tons of vinyls are converted into vinyl tape in the U.K. alone; transposed into miles of ¾" tape this runs into astronomical figures. The properties of vinyls (good electrical quality, chemical resistance, grease resistance, abrasion resistance) make it an excellent backing for adhesive tapes. In the manufacture of these tapes the compatibility of adhesive and backing is an important factor. Formulations are mostly well guarded. An often decisive problem is that of plasticizer migration, both into and out of the vinyl backing. Migration of the plasticizer may lead to too hard an adhesive layer or to a too tacky condition where the adhesive off sets onto the contacting layer of tape. This often shows up in storage, a shelf life of six months is considered a fair requirement.

Recently, vinylethers as basis for the adhesive layer have become increasingly prominent, they have good resistance to aging and sunlight. Adhesive vinyl tapes are used for: splicing and wrapping of high voltage cables, particularly in damp and oily locations; sealing of foods and perishable goods, military stores, coil wrapping, color identification, cable joining, medical purposes, floor marking.

CENTRIFUGAL CASTING OF POLYTHENE—pp 126-129

The extrusion of polyethylene pipe over 12" in diameter, becomes impractical for economical and technical reasons and centrifugal casting takes its place. Pipe up to 36"D has been successfully made. C.C. has a lower output than extrusion and of course the lengths to be made are limited (max. about 12 ft.). On the other hand installation is cheaper. For many applications the lower melt viscosity types are preferred. The gas heated rotating molds are charged with a calculated quantity of polyethylene and heated to 160-180°C. After a specified time at these temperatures(25 -40 minutes), the cooling cycle starts (about 2 hours) and the pipe can be taken out of the mold at a temperature of 40°C. Molds are constructed of brass, aluminum or steel and for better results should be highly polished, they rotate at 110-300 rpm. The mechanical properties of the cast pipes are somewhat inferior to those of extruded ones, the pipes are used for sewage and effulent drains and culverts, sometimes supported by and embedded in reinforced concrete.

RECENT DEVELOPMENTS IN CALENDERS FOR PVC. — R. S. Colborne. pp 131-139

The relative merits of the four main types of 4-roll calenders (four-in-line, L, F and Z) are discussed. The Z-type is the most popular, claimed advantages are that the contact times with the rolls are shortest and that each pair of rolls operates independently of the pressure between adjacent pairs. The rolls are generally made of cast iron and have a diameter of 24" (sometimes 28") for a length of 70". Some manufacturers use forged alloy steel rolls, surface hardened. These have less deflection so that less crown is necessary to compensate for that, the heat conductivity is higher.

Bearings are discussed in some detail. The majority has flood lubricated sleeve bearings, some have roller bearings. Roll deflection, caused by roll pressure, can be compensated for in different ways: crowning, axis crossing, counter bending. Crowning is mostly a matter of trial and error, and basically each gage film needs a different contour if the utmost precision in caliper is wanted. Of course this is not feasible. Axis crossing has been adopted by the majority of manufacturers, it is very effective in Z-calenders, applied to the final roll.

As a heating system, drilled rolls and circulating water give a better temperature control but more expensive than the steam heated cored rolls used by the majority of the German calender builders. The circuits in the drilled rolls are mostly 2" in diameter and are located 1" under the surface of the rolls.

It is important that the surface temperatures of the rolls be the same over the full length of the rolls. heat losses to bearings and gears have to be compensated for. Several systems are in use. Nip adjustment, usually motorized, and gears are discussed next. A new development, requiring much space however, is the separate gear stand, linked to the rolls with flexible couplings and separate motors driving each roll.

Safety devices, not only protecting the workers but also the equipment itself, are of course imperative and therefore, included in the discussion.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

NYLON MOLDING

(continued from the September issue)

FILTER OR SCREEN PACKS

Filters or screen pack assemblies are now suggested only when the cylinder design or capacity in relation to shot size and cycle does not always permit complete melting or fusion of the nylon, so that there is a danger of unfused particles entering the mold. The screens or plugs are not used to control or prevent drooling, and in many cases where capacity is ample they can be omitted entirely. The same nozzles may be used with or without plugs.

SCRAPS AND SPRUES

Nylon scrap of all types can be reground and reused if handled promptly with minimum exposure. Under humid conditions a heavy duty, high recovery, extra high wattage, forced draft oven is suggested. Hopper heaters of various types are recommended to prevent condensation.

NYLON MOLDING DEFECTS

Most nylon molding defects arise from improper heat application and control in the cylinder, NOT in the nozzle. Carbon specks or browning are indications of overheating, usually in the forward zone. Brittleness and lack of consistent dimensional stability are also an indication of overheating or lack of sufficient heater controls. Excess moisture content makes itself known by molding difficulties such as drooling, surprise blow backs, lack of dimensional stability or toughness and obviously, of course, by moisture marks or mica on the part surface itself.

Laminations or granules seen in the molded part, or brittleness, indicates the particular cylinder is overtaxed in terms of its ability to melt nylon, and use of a screen pack or a longer, larger capacity heater is indicated.

NYLON ANNEALING

Annealing of nylon parts is recommended where extreme dimensional stability and toughness are called for. Primarily annealing stabilizes dimensions; secondarily it relieves molding strains and helps prevent breakage where gears wheels, etc., are pressed onto shafts. Annealing time is approximately 10 minutes immersion at 350° for each ⅛" cross section.

Use of wax as an annealing medium can be considered where its subsequent presence is not objectionable as it is difficult to completely remove it. Otherwise, use of Hitec salt which can be readily removed by washing is suggested.

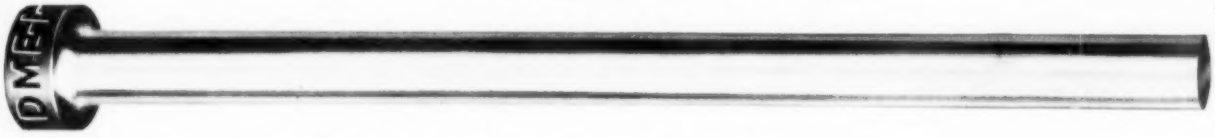
August 2, 1955

Dear Sir:

Here is a post script on the September Molderscope on Nylon Molds. Mr. A. P. Spacciapoli of Pittsburgh Plastics makes a valuable suggestion in connection with nylon molds. If

(Please turn to page 37)

Another Reason Why . . . DME **EJECTOR PINS** *are the Finest Made*



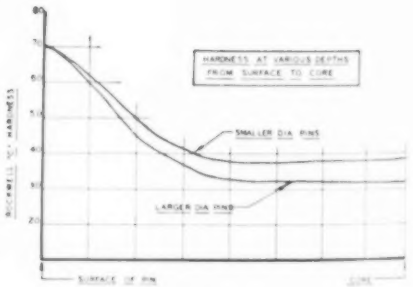
D-M-E's SPECIAL HEAT TREAT

GIVES YOU HARDNESS . . .
Where you need it most! . . . ON THE SURFACE

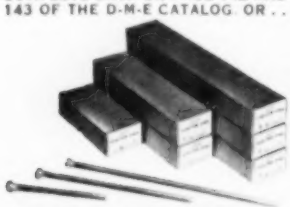
GIVES YOU TOUGHNESS . . .
Where you need it most! . . . THROUGH THE CORE

42 Standard Diameters from 1/16" to 3/4"

IMMEDIATE DELIVERY . . . 5 BRANCHES



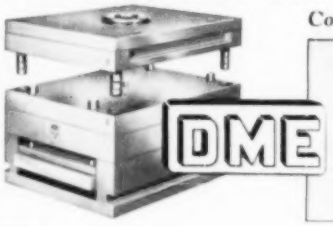
COMPLETE DATA ON PAGE 142 AND 143 OF THE D-M-E CATALOG OR . .



. . WRITE TODAY FOR THE 8 PAGE EJECTOR PIN DATA FILE!

DETROIT MOLD ENGINEERING CO.

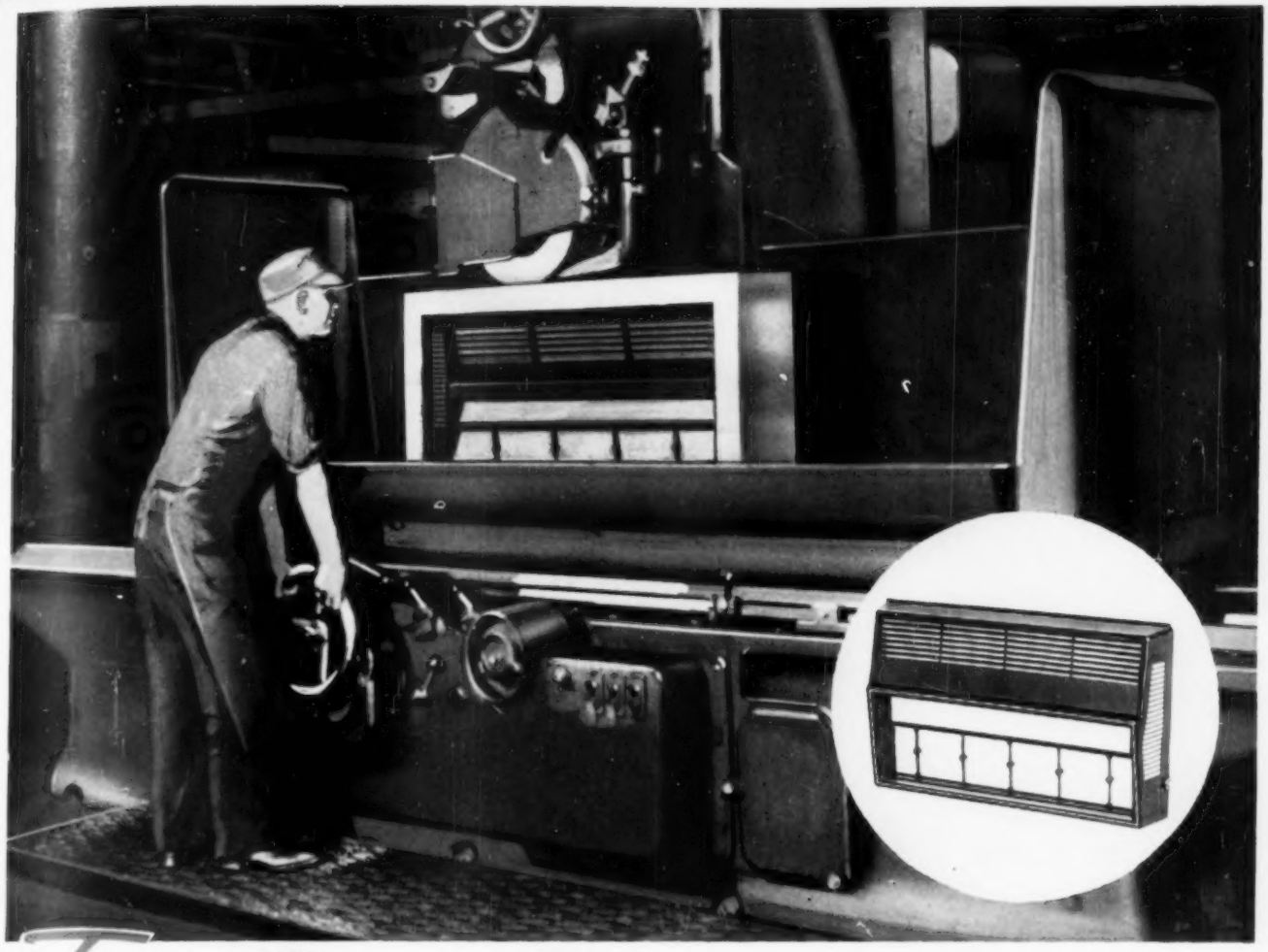
6686 E. McNICHOLS ROAD — DETROIT 12, MICHIGAN — TWinbrook 1-1300



Contact Your Nearest Branch FOR FASTER DELIVERIES!

HILLSIDE, N. J. (NEAR NEWARK) 1217 CENTRAL AVE., ELIZABETH 3-5840
CHICAGO 51, ILLINOIS 5901 W. DIVISION STREET, COLUMBUS 1-7855
CLEVELAND 14, O.—D-M-E CORP. 5473 LAKE CT., ENDICOTT 1-0907
LOS ANGELES 7, CAL. 3700 SOUTH MAIN STREET, ADAMS 3-8214

3355



For a Better Product

AT LOWER COST... A PERFECT MOLD

At Newark Die Company skilled craftsmen guide modern machines to fashion molds of superior quality . . . a vital step in making a better molded product at lower cost. Here a giant Mattison surface grinder readies a mold for the ornamental grille of an air conditioner. With unerring precision it squares the mold and smooths the parting surface to a flawless finish . . . one of the many steps in the making of a perfect mold. Into this and every stage of mold-making at the Newark Die Company goes a combination of engineering know-how, proud craftsmanship and unsurpassed facilities . . . a combination that has set mold-making standards for more than thirty years.

Write for Free Booklet "Solving Big Mold Problems"

NEWARK DIE COMPANY

22 SCOTT STREET, NEWARK 2, N. J.

Phone: MArket 2-3305

NDC TRADE MARK

Engineers—When? . . .

(Continued from page 25)

In the U.S.A. there are some 400 to 500 thousand engineers. According to Federal usage engineer means registered or graduate engineer. About 200 thousand of these are registered. Perhaps 50 percent of this 200,000 are from industry. Registration then becomes common ground to more engineers than anything else.

Another of the many trees that grew up in the engineering woods was that of state societies of professional engineers. This tree first grew in Ohio in 1878. State societies in most cases planted the registration tree and helped it grow.

The common bond which registration developed produced the National Society of Professional Engineers in 1934. Registration was made their one requirement for membership. Today there are 39 state societies banded together in NSPE and the bond that holds them together is registration. They are fast becoming the recognized voice of the registered engineer. Possibly because there are other persons in the state government who also register with the state, such as boiler or operating engineers, the founders of this movement chose an unused title or designation, Professional Engineer.

Some engineers who have not sought registration see in NSPE the hope of building a great unity organization of all engineers. Because of this they become registered in order to join NSPE. The outstanding illustration of this is:

Back in 1946 I received the results of a survey made by a National Society committee of the several G.E. plant associations. The committee had been seeking for a formula for a Unity Organization. They investigated NSPE. In their opinion NSPE could not measure up to their specifications and so they set up their own formula. Several months later they changed their mind completely and recommended that their own engineers get registered. Why? Because they had come to believe in NSPE and registration was a requirement for membership in NSPE.

But to return to my first question, "Why should Plastics Engineers seek registration?" It goes without saying that they will seek it when they want it. They will want it when they realize the recognition that comes with it. They will begin to realize that recognition when someone not a plastics engineer will not recognize them as an engineer of any kind until they are registered.

So the plastics engineers, no doubt, will talk registration among themselves. One by one they will seek registration in order to have the recognition that comes with it.

In the meantime what do registered engineers think about persons calling themselves a Society of Plastics Engineers when very few of them are registered? There probably are as many opinions as there are registered engineers. None of them exactly like it because they are hoping for the day when the word "engineer" used in any form will mean registered or professional engineer. Public opinion is moving in that direction every day.

Polyethylene Gamble . . .

(Continued from page 13)

cables is growing steadily. The publicized telephone cables to span the Atlantic and North Pacific would be vastly more difficult to handle and much more costly without polyethylene for primary insulation. Wire producers are slow to adopt a basic change in materials due to the long life of trouble free service that is required of their products. Polyethylene has proven itself and is demonstrating more effectiveness and lower costs. It is expected that an increasing number of different types of wire and cable will use it for insulation and jacketing. Telephone cable alone is likely to use 15-20 million pounds of polyethylene jacketing per year.

The significant conclusions that can be drawn from this discussion are several:

1. There is a big potential market for this very versatile and useful new family of plastics.
2. New uses are being found steadily by thoughtful engineers and production men. Hardly a week goes by but that we hear of an exciting new application. Frequently, these new uses represent markets where no plastic material had been used previously. We are not replacing other plastics, but developing a host of entirely new large volume applications.
3. Polyethylene has its limitations which future development and research work is likely to reduce. Bear in mind that polyethylene has been a seller's market for nearly its entire history. Increasing competition for your business will give you new and better products.

(Please turn to page 38)

MOLD DESIGN • **PRODUCT DESIGN** • **CONSULTATION** • **CUSTOM MOLDING**

Phone—Fort Wayne, Ind.
New Haven 5273

PRIBBLE PLASTICS PRODUCTS, INC.
(Formerly Barrier-Pribble & Co., Inc.)

554 Eben St.
New Haven, Ind.

Dear Friends:

I just returned home after speaking to the Kansas City Chapter on Sept. 6. It was a pleasure to see the energetic and sociable group there and I predict a rapid growth (Fred Sutro of that chapter is National Membership Chairman, you know).

This letter is also a public welcome to some new neighbors. We want to say to U. S. Rubber Co. that it is nice having you move your Chicago Die Mold Division to Ft. Wayne. We hope that you will have several new members for Northern Indiana SPE chapter. Mr. Jerome Jehl, who spent 6 years with us, certainly brings you a lot of knowledge and we wish you all "good luck".

Yours for better living with plastics

Wayne I. Pribble

WAYNE I. PRIBBLE

SECTION NEWS

Edited by

Stanley Bindman

Jamison Plastic Corp.
1255 Newbridge Road
North Bellmore, L. I., N. Y.

Detroit

Greetings Extended to New Society

Mac Nichols

The Detroit Chapter of the SPE heartily congratulate the founders of the newly formed organization, "Society of Diecasting Engineers."

Realizing that Dynamic Detroit was also the birthplace of the SPE, the Society of Diecasting Engineers hope to emulate the widespread growth that has been enjoyed by the Plastic Engineers who have expanded their activities internationally and have 32 active chapters throughout the Western Hemisphere.

John Micky of Ford Motor Company and Dr. E. J. Storfer of the Chrysler Corporation were honored by chairmanship appointments in the newly formed Plastics Tooling Division of the SPI. Mr. Micky was named Chairman of the Standards Committee, and Dr. Storfer heads the Technical Information Commitee.

Richard "Dick" Sullivan is now representing Detroit Mold Engineering as Sales Engineer for the state of Michigan.

Foster Gerlach, formerly with Raymond Mold Co. has resigned to form his own company, known as American Mold & Die Company at 25197 Gratiot Avenue.

Pat Luckino advises that he has changed the name of his company from Luckino Tool & Engineering Company to Continental Plastics Company.

We are sorry to report that Ray Ennis of Inland Plastics Company and his wife and children are all convalescing in the hospital in Sidney, Ohio from severe injuries sustained when they became involved in an auto accident on their way home from their Florida vacation.

The Detroit Plastic Products Company is constructing a new plant at 35135 Groesbeck Highway in Mt. Clemens, which will be ready for occupancy about February 1st. In view of their expansion program, President "Mike" Ladney wishes to announce the appointment of Bill DeGalan, Past President of the Detroit Section, formerly with Koppers Company Inc., as Chief Engineer of Special Projects.

Bill Von Goeben, associated for many years with Electric Auto-Lite in Cincinnati, is now with Valor Tool Company as Chief Engineer.

We don't know if Hugh Whitlock said "snipe hunting" or "wife hunting" when he packed his toothbrush to vacation in Florida and the Bahamas. Anyway, we bought a pound of rice—but we will not know whether to EAT it, or THROW it, until we get a full report of the trip.

The New York Low Pressure Polyester Group Photographed at A Recent Meeting

Texas

Summer Party

Tom H. Robb, Jr.

The annual summer party of the South Texas Section was held at the Elks Club, 820 Crawford Street, Houston, Texas on June 15, 1955.

After an excellent meal, the Section President, Lewis C. Williams, on behalf of the members and their wives, expressed thanks to Harlan James for his effort in securing the facilities of the Elks Club for the party. Door prizes were awarded, after which everyone retired to the bowling alleys.

Jack Stuart, with his movie camera, recorded sequences from the fast and furious contests which resulted. Although Buddy Bomar and other bowling stars seen on TV's "Championship Bowling" need have no fear for their crowns, an enjoyable time was had by all.

Tentative programs for the fall meetings are as follows: **September**—Vacuum Metalizing of Plastics, **October** — Reinforced Plastics Forum, **November**—Vacuum Forming, **December**—Annual Christmas Party.

Molderscope

(Continued from page 34)

fabricated molds are used on nylon, you can look for trouble, he correctly points out. If the tool cost will not stand hobbing or cutting the cavity and you take a nylon job based on a sectional or assembled low cost tool, you will more than likely lose your shirt running it, because the nylon will creep in where no other plastic will and ruin the mold. Once this creeping starts, the condition is almost impossible to correct, as the mold sections never go together again with a perfect fit. "Spatch" says this will be a Nylon Year and that every injection molder building nylon molds should warn his tool maker about using sectional tool construction if he wants to keep out of molding trouble.

Blueprint accuracy is yours with 'TRU-CAST'

MANCO

BERYLLIUM COPPER CAVITIES AND CORES

Write today on your company letterhead for your FREE copy of the 48-page, illustrated new 'Tru-Cast' Handbook.

MANCO PRODUCTS, Inc.
2401 Schaefer Road, Melvindale, Mich.
Telephone — Detroit: WArwick 8-7411

CLASSIFIED ADS

Situations Open

Experienced young Sales Engineer with executive ability and growth capacity. Interviews will be granted only after study of resume. Write Mr. J. H. DuBois, Mycalex Corporation of America, Box 311, Clifton, New Jersey.

Major oil company expanding in petrochemicals has two specific vacancies for chemists or chemical engineers preferably with graduate training and three to five years experience in operation of anhydrous ammonia plants or in polystyrene extrusion, injection, and vacuum molding.

Write Box 1555, SPE Journal, 34 E. Putnam Ave., Greenwich, Conn.

PLASTIC SALES ENGINEER

We are seeking a well qualified man experienced in plastics extrusion for attractive Market Development position. Kindly give your education, experience, and expected salary in complete resume. All replies will receive careful attention and will be held confidential. Write:

108 Personnel Department, Chemical Division, Koppers Company, Pittsburgh 19, Pa.

PLASTICS ENGINEERS: General American has openings in their Engineering Department for Mechanical Engineers with practical experience in any of the following fields: Injection, Compression, Reinforced Plastics or Extrusion. Apply at General American Transportation Corporation, Plant No. 1, Plastics Division, 4401 Euclid Avenue, East Chicago, Indiana.

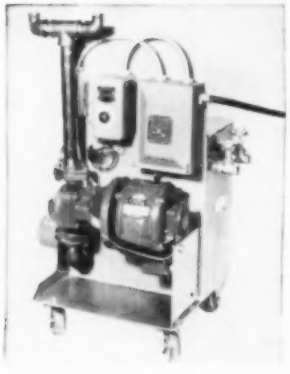
Thermosetting Plastics Engineer for laboratory and sales development.

Consolidated Paper Company
Plastics Division
Monroe, Michigan

Now

EXACT INJECTION MOLD TEMPERATURE CONTROL

at a really reasonable cost



QUICK POSITIVE HEAT

BUILT-IN COOLING

ONLY 18" x 18" FLOOR SPACE

LOWEST MAINTENANCE!

Price Complete $349.50

Range 50 - 250° — 26 GPM Pump — 4500 watt Heater. Extra Heavy Duty Relay. For 220 Volt, 60 Cycle, Single Phase Operation. Holds Heat ±2°.

The IMS Low Cost Circulator Performs The Same Job As Big Costly Units At Less Than Half The Price!

ORDER ONE TODAY!

GET THE IMS ECONOMY CIRCULATOR from INJECTION MOLDERS SUPPLY CO.

3514 Lee Road Cleveland 20, Ohio

Polyethylene Gamble . . .

(Continued from page 36)

Historically, this has been the case with every other plastic. Polyethylene will not be different in this respect.

4. Polyethylene is benefiting its users by giving better products, at lower costs. It is increasing your customers' sales and profits. A material with such versatile application and demonstrated performance cannot help but stimulate thinking by engineers of how they, too, can make better products at lower costs.
5. The polyethylene gamble of resin manufacturers is likely to pay off. The capacity now being built will not be absorbed immediately, but in time will come into closer balance with demand.

Isocyanate Resins . . .

(Continued from page 22)

Armour & Company, Chicago, Illinois
Atlas Mineral Products Company, Mertztown, Penna.
Axel Plastics Research Lamoratories, New York, N. Y.
E. I. duPont deNemours & Company, Inc., Wilmington, Delaware
Flexifoam Products Manufacturing Company, New York.
Hudson Foam Plastics Corporation, Yonkers, New York.
Isocyanate Products, Inc., Wilmington, Delaware
Magic Chemical Company, Brockton, Massachusetts
Mobay Chemical Company, St. Louis, Missouri
Nopco Chemical Company, Harrison, New Jersey
Ohio Sealer and Chemical Corporation, Brookville, Ohio
Rex Plastics Company, Buffalo, New Jersey
Schwab & Frank, Inc., Detroit, Michigan

Advertisers' Index

American Cyanamid Co. 39
Bakelite Co., Div. of Union Carbide and Carbon Corp. 7
Barrett Div., Allied Chemical & Dye Corp. 14-15
Borden Co. 8
C. H. Whitlock Associates 6
Detroit Mold Engineering Co. 34
Dow Chemical Co. 29
Durez Plastics Div., Hooker Electrochemical Co. 4
E. I. du Pont de Nemours & Co. 10
Frank W. Egan and Co. 29
Gering Products, Inc. 5
Hercules Powder Co. ..... Back Cover
Injection Molder's Supply Co. 4, 38
Manco Products, Inc. 37
Monsanto Chemical Co. 24
Newark Die Co. 35
Pribble Plastics Products, Inc. 36
Watson-Stillman Co. 2

1001 NIGHTS

and days of globe-trotting won't hurt this luggage! It's made of reinforced LAMINAC* Polyester Plastic - strong . . . lightweight . . . resistant to scuffs, scratches, stains. And the colors are brand-new in luggage. No wonder travelers like it!

Scandinavian Airlines System and other airlines like it, too, because it helps them cut luggage damage and replacement costs.

This is just one of many practical applications of reinforced LAMINAC, *the material of 1001 uses.* In the large range of LAMINAC Resins, you may well find the answer to *your* needs for a new or improved product.
Write for descriptive and technical literature.

Luggage manufactured by Alumin-Aire Luggage Co., New York, N. Y. *LAMINAC *is a registered trade-mark of American Cyanamid Co.*

AMERICAN Cyanamid COMPANY

PLASTICS AND RESINS DIVISION
32D Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto & Montreal

hercocel®

FOR PRODUCTS ON THE MOVE

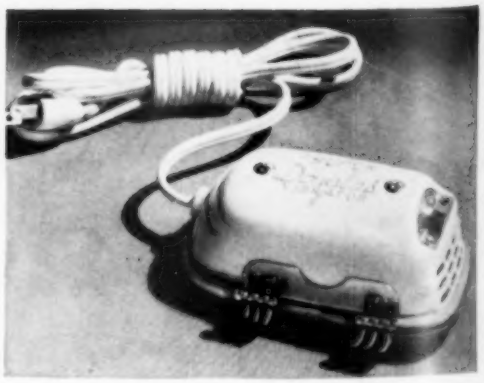
EASY TO OPERATE, you just slip the Super Douglas Vibrator over your hand. It's light in weight and durable; just right for home use.

With its glamorous Hercocel housing, the new Super Douglas Vibrator is an eye-catching, sell-on-sight item that can build bonus sales for drug stores and other specialty outlets.

Designed to provide relaxation, built to take punishment—the Douglas Vibrator is a quality product in every way. When it came to the housing, Douglas—like so many manufacturers today—turned to Hercocel, the high-quality acetate plastic that is as durable as it is beautiful.

Since Hercocel is flame-resistant and easy-to-mold, it fit perfectly into Douglas' design plans for a lightweight, Underwriter's approved vibrator, incorporating all the professional features into an attractively styled unit for family use.

From every standpoint—in design, production, and sales—versatile Hercocel keeps products on the move.



Super Douglas Vibrator is molded for Douglas Products Co., 11 Broadway, N. Y. by Moulding Corp., 53 Crosby St., New York, N. Y.

Cellulose Products Department

HERCULES POWDER COMPANY

930 King Street, Wilmington 99, Del.